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An eighth volume has been added, treating of Physiological Chemistry, the Animal Chemistry (Zoochemie) being written by Prof. LEHMANN, the Vegetable Chemistry (Phytochemie) by Prof. ROCHLEDER. This volume, which is rather an addition to Gmelin's Handbook than an integral part of it, has not been translated. The "Zoochemie," indeed, with the exception of a few recent additions, is identical with Lehmann's "Lehrbuch der Physiologischen Chemie," a translation of which by Dr. DAY was published some years ago by the Cavendish Society.

In conclusion, I beg to tender my best thanks to several gentlemen who have assisted me in the course of the work: namely, to Mr. FRANCIS RUDALL, who translated the third, and portions of the second and fourth volumes, and made several valuable additions; to Professor G. C. FOSTER, for translation of portions of the fifteenth and sixteenth volumes, and for many valuable additions; to Professor ROBINSON, of Clifton College, for translation of the seventeenth and the greater part of the eighteenth volume; to Dr. E. ATKINSON and Dr. A. DUPRÉ for portions of the thirteenth, and to Mr. A. E. FLETCHER for part of the sixteenth volume. I have also to acknowledge the assistance of the late Mr. CHARLES E. LONG in the translation of the fourteenth volume.

HENRY WATTS.

LONDON, *September*, 1871.

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Sylvinolic Acid.

$$C^{48}H^{36}O^{8} = C^{48}H^{36}O^{2},O^{6}.$$

R. Maly. *Wien. Acad. Ber.* 44, 121; *Krit. Zeitschr.* 5, 47; *J. pr. Chem.* 86, 111; *Chem. Centr.* 1862, 76; *Répert. Chim. pure* 4, 443; *Jahresber.* 1861, 389.

Formation and Preparation. When hydrochloric acid gas is passed into an alcoholic solution of abietic acid, the liquid becomes hot, and assumes a brown colour, and, after cooling, deposits sylvic acid (xvii, 318), the brown filtrate from which yields sylvinolic acid in white flocks, on addition of water.

$$C^{88}H^{64}O^{10} + 2HO = C^{50}H^{30}O^{4} + C^{48}H^{36}O^{8}? \quad (Kr.)$$

Properties. White amorphous powder, melting at 130° with decomposition. Has an acid reaction.

	a.				*b.*				Maly. *mean.*
48 C	288		74·23	50 C	300		75·00		74·55
36 H	36		9·28	36 H	36		9·00		9·24
8 O	64		16·49	8 O	64		16·00		16·21
$C^{48}H^{36}O^{8}$	388		100·00	$C^{50}H^{36}O^{8}$	400		100·00		100·00

Maly gives the formula *b*, but the formation of sylvinolic acid from abietic acid seems to support the formula with 48 atoms of carbon.

Sylvinolic acid is insoluble in *water*. — It is *bibasic*, and forms neutral salts having the formula $C^{48}H^{34}M^{2}O^{8}$.

Potash and Soda salts. — Amorphous masses, soluble in alcohol, and forming opalescent liquids in water.

Lime-salt. — Obtained by precipitating an alcoholic solution of acid with alcoholic chloride of calcium and ammonia. Bulky slightly soluble in alcohol.

	Flocks.			Maly.
$C^{48}H^{34}O^{6}$	370		86·85	
2 CaO	56		13·15	10·24
$C^{48}H^{34}Ca^{2}O^{8}$	426		100·00	

Silver-salt. — Nitrate of silver throws down from the a white powder, which reddens on exposure to light, easily in ammonia-water, and with difficulty in alcohol.

				Maly.
$C^{48}H^{34}O^{6}$	370		61·46	
2 AgO	232		38·54	37·04
$C^{48}H^{34}Ag^{2}O^{8}$	602		100·00	

Sylvinolic acid dissolves easily in *alcohol* and in *ether*, and is left behind in the form of a pitch on evaporating the solution.

Conjugated Compounds of Sylvinolic Acid.

1. Summary of the Constituents of the Pine resins.

The resinous sap which exudes from various species of conifers, contains a volatile oil (xiv, 240) and one or more non-volatile constituents, which consequently are found in turpentine, as well as in the colophony or resin obtained by distilling turpentine with water and melting the residual mass.

a. According to Unverdorben, colophony is to be regarded as impure (amorphous) pinic acid. Turpentine, French colophony, and the resin of *Pinus sylvestris*, contain also (crystallisable) sylvic acid, together with smaller portions of other resins. Trommsdorff, Rose, and Liebig likewise distinguish pinic and sylvic acids as two different acids.

b. According to Laurent, the turpentine of *Pinus maritima*, as well as the other species of pine, contains (crystallisable) pimaric acid, which is converted on standing into the isomeric pinic acid (formerly described as amorphous pimaric acid), and by distillation into the likewise isomeric sylvic acid (formerly distinguished as pyromaric acid). Strecker (*Ann. Pharm.* 68, 338) regards sylvic, pimaric, and pyromaric acids as identical, whilst according to Sievert, sylvic and pimaric acids are different; the latter, however, volatilises unaltered, so that Sievert regards Laurent's pyromaric acid as pimaric acid.

c. According to Maly, whose view is here regarded as the soundest, colophony or pinic acid is the anhydride of abietic acid, and susceptible of conversion into (crystallised) abietic acid by absorption of water. The salts of pinic acid are formed from abietic acid, by the absorption of water. The sylvic acid of Unverdorben is also abietic acid; but not that of Sievert, who decomposed abietic acid by the action of sulphuric acid, and examined the body thus formed as sylvic acid, $C^{40}H^{30}O^{4}$ (xvii, 318).— If the latter part of Maly's view is well founded, Trommsdorff, Rose, and Liebig must have examined sylvic acid, whilst it is not clear from the statements of Unverdorben and Sievert, whether they refer to the acid prepared with sulphuric acid, or to that obtained by crystallisation (Kr). — Maly is inclined to regard Laurent's pimaric acid also as abietic acid.

2. Abietic Acid.

$$C^{88}H^{64}O^{10} = C^{48}H^{34}O^{6},C^{40}H^{30}O^{4}.$$

MALY. *Wien. Akad. Ber.* 44, 121; *Krit. Z.* 86, 111; *Chem. Centr.* 1862, 73; *Rép.* [illegible]*esber.* 1861, 389. — *Ann. Pharm.* 12[illegible]

Decomposition. 1. On passing *hydrochloric acid gas* into alcoholic abietic acid, sylvic (xvii, 318,) and sylvinolic acids are formed:

$$C^{88}H^{54}O^{10} + 2HO = C^{48}H^{26}O^{8} + C^{40}H^{30}O^{4}? \quad (Kr.)$$

When abietic acid is added to boiling alcoholic hydrochloric acid, and distilled, a small quantity of oily drops, probably of an ethyl-compound, passes over.— 2. Abietic acid is but little altered in appearance by dry *chlorine*, but it evolves hydrochloric acid gas, and increases about 14·13 p. c. in weight.

The product is Maly's *dichlorabietic acid*, $C^{44}Cl^{2}H^{30}O^{5}$, in accordance with his older formula for abietic acid, $C^{44}H^{32}O^{5}$. In the formation of this body, however, 100 parts of abietic acid must have taken up 20·53 parts, and not as Maly calculates, 13·4 parts, of chlorine. The statement that this acid contains 16·92 p. c. of chlorine (calc. 17·53 p. c. Cl) is in favour of Maly's formula $C^{44}Cl^{2}H^{30}O^{5}$, or $C^{88}Cl^{4}H^{60}O^{10}$; but this formula is inconsistent with the fact that the soda-salt of the acid contains 10·45 p. c. of soda, whilst by calculation it should contain only 7·26 p. c. (Kr.). — "Dichlorabietic acid" forms a whitish-yellow mass of acid reaction, melting at 124°, with liberation of suffocating vapours. It dissolves less freely than abietic acid in hot dilute caustic soda, and is precipitated unaltered by acids. It is less soluble than abietic acid in alcohol, easily soluble in ether. Its soda-salt, obtained by adding carbonate of soda to a hot alcoholic solution of the acid and evaporating, forms an alkaline brittle resin.

3. Abietic acid dissolves easily when triturated with *oil of vitriol*, forming a reddish-brown solution, from which it is at first precipitated by water unchanged. When the solution is slightly warmed, or allowed to stand for 24 hours, it evolves sulphurous acid, after which water throws down a reddish precipitate containing sulphur, which dries up to a whitish-yellow mass over oil of vitriol. This body is decomposed at the temperature of 80° in the moist state, with liberation of sulphuric acid, and even when dry it turns soft and blackens below 100°. It has an acid reaction; forms with alkalis uncrystallisable compounds, and with baryta a compound which is insoluble in alcohol, and contains sylvic acid, together with about an equal number of atoms of sulphuric acid. It dissolves slightly in alcohol, and very easily in ether-alcohol, forming a purplish-violet solution, which turns brown on standing. — On mixing a hot alcoholic solution of abietic acid with sulphuric acid, sylvic acid is produced. No sugar is formed, even after long standing.

4. When triturated with *pentachloride of phosphorus*, abietic acid turns warm and brown and becomes fluid; the product yields on distillation, hydrochloric and chlorophosphoric acids in succession, and, lastly, at 295° to 350°, and still higher temperatures, a volatile oil, whilst charcoal remains behind (Maly).

The volatile oil, Maly's *abietone*, forms when rectified a wine-yellow fluorescent liquid, of faint aromatic odour, free from chlorine, and when rectified over sodium, free from oxygen. It solidifies to an amorphous mass in the cold. When it is submitted to fractional distillation and collected in four portions, the separate portions, the first of which distils at 295° to 303°, have the composition given below, for which Maly gives the accompanying formulæ. *Bromabietone*, obtained by dissolving the first portion in ether and adding bromine, is dark-brown, not decolorised by potash, and contains 23·6 to 27·2 p. c. bromine.

	a.		Maly.		*b.*
88 C	89·80	.....	89·84	88 C	90
60 H	10·20	.....	10·21	56 H	9
$C^{88}H^{60}$	100·00	.....	100·05	$C^{88}H^{56}$	100

5. Abietic Anhydride.

$$C^{28}H^{28}O^{6} = C^{28}H^{28}O^{4},C^{28}H^{28}O^{6}.$$

MALY. [illegible] Pharm. [illegible] Chem. 96, 140.

[illegible] any alteration at 100°, and even at [illegible] of water until it begins to be coloured [illegible] Neither [illegible] an anhydride when melted in a [illegible] heated. — But the forma- [illegible] as well as from colo- [illegible] of water, so that these bodies [illegible] abietic acid, or as mixtures [illegible] experiments show:

[illegible] is dissolved in alcohol; and [illegible] is produced; then after the [illegible] abietic acid, the whole is evaporated, [illegible] and lastly in the water- [illegible] take up 3·5 parts of water, [illegible] parts HO).

[illegible] deposits no crystals, [illegible] in alcohol of 70 p.c. [illegible] dissolved in 8 days. — Simi- [illegible] their transparency, [illegible] milky and crystalline only in [illegible]

[illegible] from pines or larches is freed from [illegible] water-bath, [illegible] an amorphous yellow [illegible] between [illegible] and [illegible] is of a syrupy con- [illegible] ether, and chloroform. This body has the composition of abietic anhydride.

				Maly. Pine and Larch resins.
88 C	528	80·73		80·23
62 H	62	9·48		9·87
8 O	64	9·79		9·90
$C^{28}H^{28}O^{6}$	654	100·00		100·00

6 Hydrabietic Acid.

$$C^{28}H^{28}O^{10} = C^{28}H^{28}O^{4},O^{6}.$$

MALY. *J. pr. Chem.* 96, 149.

Sodium-amalgam is added to a warm alcoholic solution of abietic acid so long as each fresh addition continues to prod[illegible] action, and the resulting soda-salt is allowed to [illegible] From the aqueous solution of this salt, neutral [illegible] down hydrabietate of lead, which is decomp[illegible]

is dissolved in boiling alcohol. On cooling, the solution deposits white flocks (*a*), melting at 63° to a pale-yellow oil, which solidifies to a yellow translucent brittle resin. — The alcoholic mother-liquor leaves on evaporation a brown, pitch-like sticky mass (*b*), melting at 44·5° (Stähelin & Hofstetter, *Ann. Pharm.* 51, 64).

a contains 74·66 p.c. C., 11·17 H., and 14·17 O.
b „ 73·52 p.c. C., 9·70 H., and 16·78 O.

β. Wax from the bark of Pinus sylvestris. Yellowish, melting at 54°. Smells and tastes aromatic. Evolves an odour of acrolein when heated. Inflammable; not saponifiable; insoluble in ammonia and alcohol, soluble in ether. Contains, on the average, 74·49 p. c. C., 10·30 H., and 15·21 O., corresponding to the formula $C^{98}H^{82}O^{15}$ (or $C^{26}H^{22}O^{4}$) (Stähelin & Hofstetter, *Ann. Pharm.* 51, 64).

The needles and bark of *Pinus sylvestris* yield also Kawalier's *ceropic acid.* The ceropate of lead obtained in the preparation of kinovous acid (xv, 33) is decomposed under alcohol by hydrosulphuric acid, and filtered boiling; the filtrate deposits the acid on cooling. Ceropic acid is also deposited from an alcoholic decoction of the bark on cooling; and may be obtained from an ethereal extract of the bark by recrystallisation from boiling alcohol (see xv, 34).

Ceropic acid forms microscopic white friable crystals, which melt at 100°, and solidify like bees'-wax on cooling.

	Dried in a vacuum.			Kawalier. *a.*	Kawalier. *b.*
72 C	432	74·48		74·24	75·55
68 H	68	11·72		12·17	11·32
10 O	80	13·80		13·59	13·13
$C^{72}H^{68}O^{10}$	580	100·00		100·00	100·00

a was obtained from the needles; *b* from the bark.

Ceropate of baryta is precipitated from the alcoholic acid by acetate of baryta (Kawalier, *Wien. Acad. Ber.* 11, 344).

	Dried in a vacuum.		Kawalier.
72 C	432	65·80	65·50
68 H	68	10·36	10·33
10 O	80	12·19	12·65
BaO	76·5	11·65	11·52
$C^{72}H^{68}O^{10}$,BaO	656·5	100·00	100·00

Wax from the exfoliating bark of Pinus sylvestris. — Obtained in the preparation of cortepinitannic acid, and purified by precipitating a hot alcoholic solution with alcoholic neutral acetate of lead, filtering from the grey flocks thrown down, and passing hydrosulphuric acid into the filtrate, from which, after repeated filtration, the wax crystallises. — Melts and solidifies like bees'-wax.

			Kawalier.
32 C	192	75·00	75·07
32 H	32	12·50	12·60
4 O	32	12·50	12·33
$C^{32}H^{32}O^{4}$	256	100·00	100·00

b. The hardened *white resin* from the trunk of *Pinus picea* (Duroy)

silver is thrown down. It does not precipitate cupric or plumbic salts, but gives a yellow precipitate with ferric salts. It dissolves in ether, chloroform, and absolute and ordinary alcohol.

Beta-resin or *Coriaric acid* is separated from the lead-salt by hydrosulphuric acid. Brown, inodorous and tasteless, triturable to a yellow powder, soft, and sticky between the fingers. The alcoholic solution has an acid reaction, and precipitates neutral acetate of lead white, and sesquichloride of iron and nitrate of silver pale-yellow. The resin dissolves in aqueous ammonia, from which it is precipitated by hydrochloric acid, and slightly in potash- and soda-ley. It is sparingly soluble in bisulphide of carbon; easily soluble in ether, chloroform, and alcohol; insoluble in fixed and volatile oils.

Gamma-resin or *Pinonic acid.* — Yellow, friable pieces, easily fusible, inflammable, and burning with a luminous flame. Acid in alcoholic solution. Dissolves in aqueous ammonia, and easily in ether, alcohol, and volatile oils.

Araucaric acid. — This body is extracted by boiling alcohol from the resin previously exhausted by cold alcohol, and is deposited on cooling in the form of a yellow powder, which may be decolorised by again dissolving it in alcohol. — White, indistinctly crystalline granules, easily fusible, and burning with flame. It is insoluble in aqueous ammonia; but on evaporating a mixture of the alcoholic acid and ammonia, it remains as a colourless alkaline ammonia-salt, which is insoluble in water and ether — The acid is insoluble in boiling aqueous carbonate of soda; the soda-salt obtained from an ethereal solution of the acid mixed with soda-ley, is a white amorphous powder, insoluble in water and ether, but easily soluble in alcohol. The white amorphous lime-salt precipitated from an alcoholic solution of the acid by alcoholic chloride of calcium is easily soluble in alcohol (!), insoluble in ether. — The acid dissolves in cold absolute alcohol, and in boiling alcohol of sp. gr. 0·837; it is easily soluble in ether, chloroform, and volatile oils (Peckolt, *N. Br. Arch.* 122, 225).

i. *Resins from Oil of Turpentine.* — The products formed from oil of turpentine by exposure to the air (xiv, 245), or by the action of nitric acid (xiv, 249) bear no perceptible relation to the pine-resins. — When oil of turpentine is allowed to resinise in the air, formic acid is among the products obtained. The colophony-like mass does not yield abietic acid (Maly).

On dropping oil of turpentine in small portions into nitric acid, and heating so long as red fumes are emitted, an acid solution and a mixture of resins are obtained. The latter is either (after short exposure to the action of the acid) red-brown, soft, and almost entirely soluble in alcohol, or (after prolonged boiling) yellow and friable. In the latter case a solution of the resin in boiling alcohol deposits terepthalic acid (xiii, 13), whilst the residue left on evaporation gives up to boiling water terebenzic acid (xvi, 183), three other resins free from nitrogen remaining undissolved.

a. Alpha-resin. — Insoluble in cold, but soluble to a slight extent in boiling alcohol, from which it is deposited as a yellow, amorphous powder. Insoluble in ammonia and caustic potash. Melts above 100°.

When purified by washing with warm alcohol and ammonia, it contains 56·36 p.c. C., 5·65 H., and 37·99 O., corresponding to the formula $C^{40}H^{30}O^{8}$ (calc. 56·60 C., 5·66 H.).

b. *Beta-resin.* — Soluble in cold alcohol, but insoluble in ammonia and caustic potash. Melts below 100°. Contains, after drying at 100°, 70·12 p.c. C., 7·31 H., and 22·57 O., agreeing therefore with the formula $C^{40}H^{30}O^{10}$ (calc. 69·77 C., 6·97 H.).

c. *Gamma-resin.* Semifluid at 100°. Soluble in cold alcohol, and in ammonia and caustic potash. Contains, after drying at 100°, [illegible] p.c. C., 6·21 H., and 32·63 O., corresponding to the formula [illegible] (calc. 61·22 C., 6·12 H.) (Caillot, *N. Ann. Chim. Phys.* [illegible]).

Organo-nucleus $C^{40}NH^{30}O^{4}$.

Delphinine.

$$C^{40}NH^{30}O^{4} = C^{40}NH^{27}O^{4}.H^{2}.$$

Brandes. *Schw.* 25, 369; *N. Tr.* 3, 2, 145.
Lassaigne and Feneulle. *Ann. Chim. Phys.* 12, 358; *Gilb.* [illegible]; *N. Tr.* 4, 2, 199.
Feneulle. *J. Pharm.* 9, 4; *Schw.* 42, 116.
O. Henry. *J. Pharm.* 18, 663; 19, 593; *Report.* 44, 73; *Schw.* [illegible]; *N. Tr.* 26, 2, 240.
Couerbe. *Ann. Chim. Phys.* 52, 350; *J. Pharm.* 19, 519; *Ann. Pharm.* 6, 100.
J. Erdmann. *N. Br. Arch.* 117, 43; *N. Report.* 13, 86.

Delphine. Discovered by Brandes and by Lassaigne and Feneulle simultaneously, in 1819, in the seeds of *Delphinium Staphisagria*, but first distinguished and separated from staphisagrine by Couerbe. Occurs in the seeds to the amount of [illegible] p.c. (Erdmann); more abundantly in the grey or brown than in the black seeds (Couerbe).

Preparation. 1. Powdered stavesacre seeds, made into a pulp with a moderate quantity of water, are heated in a water-bath for some days and pressed while still warm to remove the greater part of the fat, by which process but little delphinine is lost, if the quantity of water employed be not too great. The residual mass, digested with strong alcohol for six or eight hours and pressed, yields a tincture from which the alcohol is distilled. There then remains an oily resinous mass from which the alkaloids are separated by treating it with weak hydrochloric acid, precipitating the filtrate with ammonia, washing, and drying. The mixture of bases thus obtained is [illegible] with [illegible] when impure staphisagrine is left in the form of [illegible] the delphinine is dissolved. The latter body is [illegible] by [illegible] ting the solution, dissolving the residue in [illegible] tating with ammonia, washing, drying, ac[illegible] evaporating (J. Erdmann).

2. An extract of the seeds, prepared [illegible] with water containing sulphuric [illegible]

Primary Nucleus $C^{48}H^{40}$; *Oxygen-nucleus* $C^{48}H^{38}O^{2}$.

Kinovic Acid.

$$C^{48}H^{38}O^{8} = C^{48}H^{38}O^{2}.H^{6}.$$

[illegible]

[illegible] together with kinovin in the East Indian cinchona trees [illegible] *Potentilla Tormentilla* (Rembold, *Ann.* [illegible] together with kinova-sugar (xv, 345) [illegible] hydrochloric acid:

$$C^{48}H^{38}O^{8} + 2HO = C^{48}H^{38}O^{2} + C^{12}H^{12}O^{10} \text{ (Hlasiwetz).}$$

[illegible] Dry hydrochloric acid gas is passed into a solu- [illegible] whereupon the liquid becomes hot [illegible] crystalline powder, which is purified by washing [illegible] and recrystallising from a large quantity of boiling [illegible] yield a further quantity after distilling [illegible] Hlasiwetz.

¶ [illegible] (*Wien. Acad. Ber.* 56, 2 *Abth.* 97; [illegible] kinovic acid is produced by treating kinovin with [illegible] The kinovin then dissolves (with the [illegible] a few flocks of a brownish waxy substance), forming a [illegible] evaporation leaves crystalline kinovate of [illegible] separated from the mother-liquor, and decomposed [illegible] hydrochloric acid, yields pure kinovic acid.

2. [illegible] twice exhausted by boiling with thin milk of [illegible] the washed precipitate boiled with [illegible] precipitated with hydrochloric [illegible] dissolved in a large quantity of hot [illegible] decolorized with animal charcoal. [illegible] pure kinovic acid separates as a [illegible] crystalline powder (Rembold).¶

Properties. Dazzling-white loose crystalline powder, consisting, according to Grailich, of microscopic six-sided laminæ of the right prismatic system. Tasteless (Hlasiwetz). In ammoniacal solution it exerts a right-handed action on polarised light. $[\alpha]_j = 76{\cdot}5°$ (De Vrij). It does not lose weight at 140° after drying at 100° (Hlasiwetz).

	Dried at 100°.		Hlasiwetz. *mean.*
48 C	288	73·84	73·60
38 H	38	9·74	9·85
8 O	64	16·42	16·55
$C^{48}H^{38}O^{8}$	390	100·00	100·00

Decompositions. 1. Kinovic acid melts when heated, [illegible] solidifying to a fissured mass; when more strongly he[illegible]

Calculations according to Hlasiwetz.

	a.				*b.*		
60 C	360		67·16	60 C	360		68·31
48 H	48		8·95	47 H	47		8·91
16 O	128		23·89	15 O	120		22·78
$C^{60}H^{48}O^{16}$	538		100·00	— HO	527		100·00

	c.		
60 C	360		69·49
46 H	46		8·88
14 O	112		21·63
$C^{60}H^{48}O^{16}$–2 HO	518		100·00

	Petersen.	Schneder-mann. *dried.*	Schwarz. *at* 100°.	*at* 100°.	Hlasiwetz. *at* 140°.	*at* 180°.
C	66·65	67·13	68·89	66·05	66·57	68·33
H	8·94	8·98	8·86	8·93	8·88	9·03
O	24·41	23·89	22·25	25·02	24·55	22·64
	100·00	100·00	100·00	100·00	100·00	100·00

According to Petersen, the formula is $C^{15}H^{12}O^{4}$; according to Schnedermann $C^{28}H^{30}O^{10}$. — Hlasiwetz's third analysis corresponds with the formula *b*; that of Schwarz with *c*, both of which are derived from *a* by the abstraction of 1 or 2 atoms of water.

Decompositions. 1. Kinovin when *heated*, melts to a pale-yellow thick liquid, which solidifies to a friable resin on cooling. When more strongly heated it boils, evolves a peculiar odour, takes fire, and burns with a red smoky flame (Winckler). Submitted to dry distillation, either alone or mixed with sand, it yields an acid [acetic acid (Buchner)], an empyreumatic thin turbid liquid containing aldehyde, and afterwards an amber-yellow heavy liquid, which solidifies to a resin containing, after solution in alcohol and evaporation, 85·44 p. c. C., 10·93 H., and 3·63 O. — Kinovin mixed with lime and subjected to dry distillation yields water, then yellow metacetone, and lastly the above resin (Hlasiwetz). — 2. *Oil of vitriol* poured upon kinovin colours it brown and gradually dissolves it, with dark-red colour (Winckler). The solution is brown at first, but changes to blood-red, fine red-brown, and ultimately a paler colour. Water throws down from the red solution apparently unchanged kinovin, and from that which has become paler, kinovin which is no longer bitter (Buchner). — Kinovin dissolved in alcohol breaks up into kinovic acid and kinova-sugar (xv, 345) on passing *hydrochloric acid gas* into the solution;

$$C^{60}H^{48}O^{16} + 2HO = C^{48}H^{38}O^{8} + C^{12}H^{12}O^{10} \text{ (Hlasiwetz).}$$

4. Kinovin dissolves in boiling *nitric acid* with yellow colour, leaving a white granular powder. When the solution is heated till the red fumes disappear, water throws down white flocks, whic[illegible] when dissolved in hot alcohol and evaporated, yield [illegible] yellow resin (containing 60·94 p. c. C., 6·67 H., and 32·[illegible] a powder insoluble in alcohol (containing 58·25 p. c. C., [illegible] 35·55 O.) (Hlasiwetz). For the former body Hlasiwetz gives the for[illegible] and for the latter $C^{24}H^{15}O^{11}$. Kinovin dissolves in strong nitric acid, f[illegible] solution, from which it is precipitated unaltered by water, and whi[illegible] oxalic acid (Buchner).

in colour and less rich in copper, when the acetate of copper contains free acetic acid, or when the alcoholic solution is too weak (Schnedermann).

Two-thirds Kinovin-copper-oxide.			Schnedermann. *at* 100°.	*mean.*
120 C	720		61·32	61·44
94 H	94		8·00	8·00
30 O	240		20·44	19·79
3 CuO	120		10·24	10·77
$2C^{40}H^{67}O^{13},3CuO$	1174		100·00	100·00

According to Schnedermann, $C^{38}H^{70}O^{8}$, CuO.

Kinovin and Silver-oxide.—According to Schnedermann, aqueous kinovin-magnesia precipitates silver salts, but according to Pelletier & Caventou it does not.—Kinovin-lime throws down from silver salts a white jelly (Winckler). By precipitating kinovin-ammonia with nitrate of silver a white precipitate is obtained, which turns brown-black on drying (Schnedermann).

The magnesia-compound precipitates cinchonine salts (Pelletier & Caventou).

Kinovin dissolves freely in *alcohol*, from which it is precipitated by *water* (Pelletier & Caventou). It is less freely soluble in *ether* (Winckler); dissolves also in *fixed and volatile oils*, especially when warm (Buchner).

Oxygen-nucleus $C^{40}H^{36}O^{4}$.

Dyslysin.

$$C^{40}H^{36}O^{6} = C^{40}H^{36}O^{4},O^{2}.$$

BERZELIUS. *Ann. Pharm.* 33, 139.
THEYER & SCHLOSSER. *Ann. Pharm.* 50, 244.
STRECKER. *Ann. Pharm.* 67, 29; 70, 149
MULDER. *Scheik. Onderz.* 5, 1.
HOPPE-SEYLER. *J. pr. Chem.* 89, 83.

The ultimate product obtained by the prolonged boiling of bile with hydrochloric acid, the cholic acid (choloïdic acid) formed by the breaking up of taurocholic and glycocholic acids, losing 4 atoms of water to form dyslysin.—Formed also by heating cholic acid to 195—200° (Hoppe Seyler), to 300° (Strecker).

Bile, dissolved in a small quantity of water, is boiled for a day with strong hydrochloric acid; the resin thereby separated is treated with boiling water, which takes up only a small quantity if the action of the hydrochloric acid has been sufficiently prolonged; the residue is boiled with absolute alcohol; and the precipitate which forms on cooling is added to the undissolved portion. A further quantity of dyslysin may be obtained by evaporating the wash-waters and alcohol to dryness, and again boiling the residue with hydrochloric acid. The whole of the dyslysin thus obtained is dissolved in ether, and the solution is filtered and evaporated (Theyer & Schlosser).—Strecker boils glycocholic acid

was obtained by heating aphrodescin-baryta for some time with alc and hydrochloric acid, and precipitating with water.

	at 130°.		Rochleder.
68 C	408	66·34	66·32
55 H	55	8·94	9·19
19 O	152	24·72	24·49
$C^{68}H^{55}O^{19}$	615	100·00	100·00

5. Ae + 2M + 2P − 12HO = $C^{84}H^{82}O^{34}$ (*Argyraescetin*). — Obtai by heating argyraescin with acids. See below.

6. Ae + 2M + S − 4HO = $C^{84}H^{70}O^{36}$ (*Telaesglucin*). — *a.* Obtai on one occasion by heating crystallised aescinate of potash with w hydrochloric acid for six hours over the water-bath. — *b.* This bod obtained in the form of a precipitate by warming the aqueous ext of ground horse-chestnuts with hydrochloric acid, boiling the precipi with alcohol, filtering, boiling the filtrate with excess of baryta-wa filtering the hot liquid from the precipitate, dissolving the latter in water, filtering when the solution has cooled to 30°, and mixing filtrate with hydrochloric acid.

	at 100°.		Kavalier. *a.*
84 C	504	58·47	58·55
70 H	70	8·12	8·34
36 O	288	33·41	33·14
$C^{84}H^{70}O^{36}$	862	100·00	100·00

	Dried in a vacuum.		Schwarz. (*mean.*) *b.*
84 C	504	56·12	56·22
74 H	74	8·24	8·19
40 O	320	35·64	35·59
$C^{84}H^{70}O^{36},4HO$	898	100·00	100·00

7. Ae + 2M + 2S − 6HO = $C^{96}H^{80}O^{46}$ (*Aescinic acid*). — Produ by heating argyraescin or aphrodaescin with strong aqueous alkalis the former case together with propionic acid, in the latter with but acid. See below.

8. Ae + 2M + 2S + P − 10HO = $C^{102}H^{82}O^{46}$ (*Propaescinic a* Obtained, like aescinic acid, as an intermediate product of the lim action of alkalis on argyraescin. See below.

c. Argyraescetin.

$$C^{84}H^{62}O^{24} = C^{48}H^{32}O^{8},2C^{12}H^{10}O^{6},2C^{6}H^{6}O^{3}.$$

ROCHLEDER. *Wien. Acad. Ber.* 45, 676; *J. pr. Chem.* 87, 6; 417.

Formation. See above.

Hydrochloric acid gas is passed into alcoholic argyraescin;

decoction deposits, on cooling, a small quantity of aescinic acid, amounting to 0·6 grm. from 8 pounds of chestnuts.

2. *From the Alcoholic extract of the Cotyledons.* To prepare this extract, fresh ripe horse-chestnuts freed from the brown skins and embryos, are comminuted and digested for a few days with alcohol of 35° Bm. in the cold. The extract is decanted and replaced once or twice by fresh alcohol, and the mixed tinctures are distilled until the residue has the consistence of honey. After standing in a warm place for some days, a layer of fat collects on the surface, on removing which the alcoholic extract remains as a brown mass. — Before proceeding to the further treatment of the extract, the sugar contained in it may be removed by fermentation, or by evaporating the extract to an unctuous consistence and kneading it with absolute alcohol.

a. An aqueous solution of the above extract, after being freed from the alcohol taken up in the process of kneading, is heated with potash-ley till it solidifies to a jelly from separation of aescinate of potash. It is then boiled with water and filtered, and the salt which crystallises on cooling is washed and decomposed with an acid. — *b.* The fermented solution of the extract, after precipitation with neutral acetate of lead, is precipitated with the basic acetate; the precipitate is decomposed with hydrosulphuric acid under weak spirit; the filtrate is evaporated to dryness; and the residue is boiled with potash-ley and a little alcohol. The aescinate of potash thereby separated is heated with alcoholic acetic acid and mixed with water, whereupon aescinic acid is deposited.

Aescinic acid is also obtained in the preparation of argyraescin.

Properties. Amorphous colourless mass, easily triturable to a white powder. The acid, dried at 100° and afterwards boiled with a quantity of alcohol of 40° B. insufficient to dissolve it, is converted into a crystalline powder: the solution likewise deposits crystalline acid on evaporation. — The acid dried at 115° loses ½ atom of water at 130° (by calc. 0·44 p. c.).

			Rochleder, Schwarz, and Kavalier.				
			a.		*b.*	*c.*	*d.*
96 C	576	56·25	55·29	55·26	56·29	56·68	56·91
80 H	80	7·11	8·09	7·73	8·07	7·90	7·99
46 O	368	35·94	36·62	37·01	35·64	35·42	35·10
$C^{96}H^{80}O^{46}$	1024	100·00	100·00	100·00	100·00	100·00	100·00

The analyses are given in mean numbers. — *d* was dried at 130° and had lost a little water between that temperature and 115°. Rochleder regards *a*, *b*, and *c* as aescinic acid containing different proportions of water. All three, however, were dried at 100° and at 115° by turns; whilst acid dried in a vacuum over oil of vitriol contained the same percentage of carbon as that dried at 115°. According to Rochleder, the above formula is correct for *b*, whereas *a* contains 2 atoms of water more, *c* 1 atom, and *d* 1½ atom less.

Rochleder now assigns to aescenic acid the formula $C^{48}H^{40}O^{24}$, which requires 55·38 p. c. C., 7·69 H., and 36·93 O.

Decompositions. Aescinic acid turns yellow when *heated* above 130°. — When heated with *hydrochloric acid* it breaks up, with formation of sugar, and a second body consisting of either telaescin, telaesglucin, or aescigenin.

e. Propaescinic acid.

$$C^{102}H^{82}O^{46} = C^{48}H^{36}O^{6},2C^{12}H^{10}O^{8},2C^{12}H^{10}O^{10},C^{6}H^{5}O^{6},HO.$$

ROCHLEDER. *Wien. Acad. Ber.* 45, 675; *J. pr. Chem.* 87, 9.

Not named by Rochleder. — Occurs in the cotyledons of the horse-chestnut. — For its formation see page 34.

When argyraescin is dissolved in potash-ley of sp. gr. 1·27, and the solution is heated over the water-bath until the jelly first formed is liquefied, the liquid, on cooling, solidifies to a crystalline pulp of propaescinate of potash. The crystals are purified by pressure and recrystallisation from hot alcohol. — The propaescinic acid obtained in the preparation of argyraescin is powdered and boiled with absolute alcohol, which dissolves it slowly and deposits brown flocks on cooling. These brown flocks are re-dissolved with the exception of a slight brown residue, in hot absolute alcohol, and the whole of the alcoholic liquids are precipitated with strongly cooled ether. The precipitate is washed with ether and purified by repeatedly dissolving it in alcohol and precipitating with ether.

	Dried at 130°.			Rochleder. *a.* *mean.*		*b.*
102 C	612		57·63		57·60	58·43
82 H	82		7·72		7·88	7·65
46 O	368		34·65		34·52	33·92
$C^{102}H^{82}O^{46}$	1062		100·00		100·00	100·00

Rochleder gives for *b* the formula $C^{102}H^{80}O^{44}$, containing two atoms of water less than the above (calc. 58·62 p. c. C., 7·66 H.).

Propaescinic acid is converted by heating with *alkalis* into aescinic acid, with elimination of propionic acid.

The *potash-salt* forms white microscopic crystals.

Baryta-salt. — Thrown down as a dense white precipitate on adding chloride of barium to a solution of the potash-salt in weak spirit.

	at 115°.			Rochleder. *mean.*
102 C	612		43·58	43·48
86 H	86		6·12	6·03
50 O	400		28·48	28·55
4 BaO	306·4		21·82	21·99
$C^{102}H^{80}O^{46},4BaO + 6HO$	1404·4		100·00	100·00

f. Argyraescin.

$$C^{105}H^{86}O^{48} = C^{48}H^{36}O^{6},2C^{12}H^{10}O^{8},2C^{12}H^{10}O^{10},2C^{6}H^{5}O^{3}.$$

ROCHLEDER. *Wien. Acad. Ber.* 45, 675; *J. pr. Chem.* 87, 3; 101, 417.

According to Rochleder, Frémy's *saponin* (xvi. 84) from horse-chestnuts is to be regarded as aphrodaescin, whilst Frémy's crystalline bitter substance [*Acide esculique?* (Kr.) xv, 53] is argyraescin. Saponin does not occur in ripe horse-chestnuts.

of lead contained also argyraescin. — The filtrate from the precipitate formed by the neutral acetate gives with the basic acetate a precipitate of argyraescin, aphrodaescin, aescinic acid, and the colouring matter which yields quercetin with acids.

c. On mixing a solution of the extract in a large quantity of water with neutral acetate of lead, removing the precipitate, adding to the filtrate basic acetate of lead mixed with an equal volume of alcohol of 35° B., and washing the precipitate thereby formed with hot alcohol, the portion remaining undissolved (α) contains aphrodaescin-lead and the colouring matter which yields quercetin, whilst argyraescin, aphrodaescin, and propaescinic acid remain in solution, and may be precipitated by water (precipitate β). α is decomposed by hydrosulphuric acid under weak alcohol; the filtrate is evaporated; the residue is dissolved in water, and the solution shaken with crystals of hydrate of baryta, whereupon aphrodaescin-baryta is thrown down. — β is decomposed by hydrosulphuric acid under alcohol; and the filtrate is evaporated to crystallisation, whereupon the argyraescin separates. On evaporating the mother-liquor and mixing the residue with cold water, a little more argyraescin remains undissolved. If the solution be again evaporated, and the residue mixed with hot water, the solution becomes turbid and deposits propaescinic acid in the form of a jelly, whilst the filtrate yields aphrodaescin-baryta on addition of baryta.

Properties. See hydrated argyraescin. This body is rendered anhydrous by exposure to a temperature of 130° in a current of carbonic acid.

	Dried at 130°.		Rochleder. *mean.*
108 C	648	57·96	57·82
86 H	86	7·69	7·77
48 O	384	34·35	34·41
$C^{108}H^{86}O^{48}$	1118	100·00	100·00

Rochleder now represents argyraescin by the formula $C^{54}H^{42}O^{24}$, requiring 58·06 p. c. C., 7·53 H., and 34·41 O. (see p. 43).

Decompositions. 1. Argyraescin melts on platinum foil to an amorphous yellowish mass, which afterwards puffs up, emitting an odour of incense, burns with bright smoky flame, and leaves a dense charcoal. — 2. It dissolves in cold *oil of vitriol* with pale golden-yellow colour; on dropping water into the solution, so that it becomes hot, it turns blood-red, and on addition of a large quantity of water deposits greyish-green flocks, evolving at the same time an odour of fatty acids. — 3. When heated with *mineral acids*, it is resolved into argyraescetin and sugar. Hydrochloric acid gas passed into hot alcoholic argyraescin colours the liquid yellow, afterwards red by transmitted light, with green fluorescence, and quickly effects the splitting up into argyraescetin and sugar; but secondary products are apt to be formed. The aqueous solution becomes turbid and deposits flocks when warmed with hydrochloric acid, but for complete decomposition an exposure to a temperature of 100° for six or eight hours is necessary. 100 parts of the crystallised monohydrated argyraescin thus treated yield 3[illegible] parts, whilst 100 parts of the amorphous ter-hydrate yield 31·43 pa[illegible]

	Dried.		Strecker. *mean.*	Gorup-Besanez.	Theyer and Schlosser.
48 C	288	70·59	70·52	69·45	69·65
40 H	40	9·80	9·87	10·05	9·80
10 O	80	19·61	19·61	20·50	20·55
$C^{48}H^{40}O^{10}$	408	100·00	100·00	100·00	100·00

The acid analysed by Gorup-Besanez, and that of Theyer and Schlosser, probably contained some of the bi-hydrated acid, which gives off its water with difficulty (Strecker). — Theyer and Schlosser give the formula $C^{48}H^{38}O^{9}$.

Decompositions. 1. Dehydrated cholic acid melts at 195°, giving off 2·3 p. c. of water (1 atom = 2·21 p. c. HO), and forming a colourless liquid which, on cooling, solidifies to a mass resembling choloïdic acid (p. 53): above 200° it becomes thick, and about 300° turns brown and is converted into dyslysin, with elimination of 7·3 p. c. water: $C^{48}H^{40}O^{10} = C^{48}H^{36}O^{6} + 4HO$ (calc. 8·82 p. c. HO) (Strecker). See also p. 54. — 2. Cholic acid submitted to *dry distillation* yields an acid faintly yellow oil, which dissolves in ether and alkalis, and forms amorphous precipitates with metallic salts; a small quantity of charcoal is left behind (Strecker). — 3. Cholic acid *burns* with a very smoky flame, leaving charcoal (Demarçay). — 4. By boiling with strong *hydrochloric acid*, it is converted into choloïdic acid, and ultimately into dyslysin (Strecker).

5. Cold *nitric acid* has no action on cholic acid, but the hot acid dissolves it with violent frothing and evolution of nitric oxide, forming a dark-yellow liquid, which after long-continued action contains cholesteric acid (xiii. 157), but no volatile fatty acid (Schlieper). See also choloïdic acid. — 6. Cholic acid, heated to 200° with *glycerin*, yields a mixture of glycerides (Hoppe-Seyler). — 7. Heated with *oil of vitriol* it behaves like glycocholic acid (p. 58) (Städeler); warmed with oil of vitriol and a little sugar-solution, it exhibits a violet-red colour (Strecker).

Combinations. — *With Water.* A. *With 1 atom of Water?* The salt with 2 atoms of water retains 1 atom at 100°, or gives it off with difficulty only at that temperature (Strecker).

	at 100°.		Strecker. *mean.*
48 C	288	69·06	68·97
41 H	41	9·83	9·83
11 O	88	21·11	21·20
$C^{48}H^{40}O^{10}$ + aq.	417	100·00	100·00

B. *With 2 atoms of Water.* — Obtained by precipitating the aqueous soda-salt with hydrochloric acid, in presence of ether, and setting aside for some days (Hoppe-Seyler). It crystallises from its alcoholic solution mixed with water in needles, and from ether in colourless transparent tables (Strecker). Right prismatic. Fig. 62 without *p*, but with the edge *u′ : u* truncated by a face *t*. Four faces of the octohedron, which would together form a horizontal prism, are more developed than the other four, so that the crystals are terminated above, not with an octohedral summit, but with an edge, and exhibit an oblique prismatic character. The contiguous octohedral faces opposite this edge intersect at an angle of 71° 58′. The acute prismatic angle = 62° 15′ (Kopp).

The acid loses 2·4 p. c. water at 100° (1 at. = 2·11 p. c. HO),

and 2·4 p. c. more at 140°; turns yellow at 145°, and melts at 145° to 150°, without undergoing decomposition (Strecker). It dissolves with difficulty in ether, but more easily in alcohol, the latter solution quickly depositing crystals containing 5 atoms of water (Hoppe-Seyler).

			Dumas and Pelouze.	Strecker.
48 C	288	67·61	67·2	67·34
42 H	42	9·86	9·7	10·00
12 O	96	22·53	23·1	22·66
$C^{48}H^{42}O^{12}$ + 2aq.	426	100·00	100·0	100·00

C. *With 5 atoms of Water.* — Obtained by dissolving in alcohol the crystals deposited from ether, and evaporating (Hoppe-Seyler). Brittle, colourless glassy tetrahedrons, or quadratic octahedrons, which effloresce and become opaque in dry air. The crystals obtained from boiling alcohol belong to the square prismatic system. They are either octahedrons with the obtuse lateral summits truncated (fig. 23, but with the *q*-faces much smaller, so that the lateral edges of the octahedron are still partly developed; $e : e = 117° 14'$; $e : e = 95° 40'$; or they are the tetrahedrons derived from the octahedrons, in which the *q*-faces appear as truncations of the zig-zag edges. The angle between these edges = 63° 46' (Kopp, *Ann. Pharm.* 67. 5). Kobell (*Ann. Pharm.* 59. 143) found the same octahedrons and determined the angles as approximately 117° and 95° 30'.

This acid loses at 100° the whole of its water, amounting on the average to 9·9 p. c (5 at. = 9·34 p. c. HO), and suffers no further change at 170° (Strecker). It rotates a ray of polarised light to the right. $[\alpha]D = 31·2°$ for the acid with 5 atoms of water (Hoppe-Seyler).

D. *Aqueous solution.* — The acid with 5 atoms of water dissolves in 750 parts of boiling, and in 4,000 parts of cold water (Strecker).

These solutions deposit microscopic pyramids and prisms with six faces, apparently inclined at equal angles, and terminated by end-faces at right angles to the longitudinal axis (Hoppe-Seyler).

Salts of Cholic Acid. — The acid neutralises bases, and decomposes carbonates with effervescence, forming salts soluble in alcohol but insoluble in ether; the salts of the alkalis dissolve also in water. The salts have a bitter and somewhat sweet taste: they produce a violet-red coloration with oil of vitriol and sugar (Strecker). The aqueous cholates of the alkalis are precipitated by chloride of sodium (Theyer and Schlosser). The stronger acids throw down from the salts amorphous cholic acid as a pasty precipitate, which is easily soluble in alcohol and ether, less freely soluble in water, and rapidly becomes crystalline.

Cholate of Ammonia. — The acid dissolves easily in dilute ammonia. On passing ammonia-gas into alcoholic cholic acid, and mixing the product with ether, needles or prisms are deposited, which lose ammonia on exposure to the air or on boiling, and leave an acid residue on evaporation (Strecker).

Cholate of Potash. — The alcoholic acid, neutralised with caustic potash and mixed with ether, deposits, on standing, needles of the

potash-salt, which are likewise formed on evaporating the solution (Strecker). The salt is also formed by evaporating a solution of the acid to dryness with carbonate of potash, exhausting the residue with absolute alcohol, and evaporating to crystallisation (Hoppe-Seyler). After drying at 100 it does not undergo change at 150°. The aqueous solution leaves an amorphous varnish on spontaneous evaporation (Strecker). Exerts a right-handed action on polarised light; $[\alpha]D = 30{\cdot}8°$ in alcoholic solution, and consequently $= 33{\cdot}7°$ for the acid contained in the salt. In aqueous solutions the rotatory power depends on the concentration, and is greater in dilute than in strong solutions: it is also diminished by the addition of potash-ley (Hoppe-Seyler). The salt has a faintly alkaline reaction (Strecker).

	at 100°—150°.			Strecker. *earlier.*		*later.*
48 C	288		64·56		63·94	64·63
39 H	39		8·74		8·76	8·76
9 O	72		16·14		16·78	16·20
KO	47·1		10·56		10·52	10·41
$C^{48}H^{39}KO^{10}$	446·1		100·00		100·00	100·00

The above salt, but no acid salt, is precipitated by ether from an alcoholic solution of the potash-salt mixed with excess of cholic acid (Strecker).

Cholate of Soda.—Precipitated in tufts of long fine needles on mixing an alcoholic solution of the salt with an equal volume of ether. Has a pure bitter taste. Dissolves easily in water, alcohol, and acetic acid (Theyer and Schlosser).

The soda-salt exerts a right-handed action on polarised light: in the alcoholic solution $[\alpha]D = 31{\cdot}4°$ for the salt, $= 33{\cdot}1°$ for the acid contained in it. In aqueous solution the rotatory action is less, $[\alpha]D = 25{\cdot}0°$, and varies with the strength when the solution contains less than 9 grammes in 100 cubic centimetres (Hoppe-Seyler).

	at 120°.			Theyer and Schlosser.
48 C	288		66·98	66·71
39 H	39		9·07	9·40
9 O	72		16·73	16·50
NaO	31		7·22	7·39
$C^{48}H^{39}NaO^{10}$	430		100·00	100·00

Cholate of Baryta.—Chloride of barium throws down a floccul precipitate from concentrated aqueous solution of cholate of pota solutions containing 3 p. c. or less of the potash-salt are not prec tated (Strecker). On dropping hot alcoholic cholic acid into boi baryta-water, dense flocks of the baryta-salt are precipitated, w must be washed with warm water free from air (Theyer and Schlos A solution of cholic acid in excess of baryta-water is treated with too much) carbonic acid, then boiled and evaporated to crystalli (Strecker).—Silky crystalline crusts soluble in 30 parts of cold 23 parts of boiling water, and more freely in alcohol, from wl crystallises (Strecker). The salt is precipitated by water fr solutions in alcohol and in acetic acid (Theyer and Schlosser) aqueous and the alcoholic solutions are decomposed by prolonge ment with carbonic acid, without yielding an acid salt (Strecke

Properties. Very delicate white needles, which, when pressed between blotting paper, aggregate into laminæ, having a faint silky lustre, and an intensely sweet, somewhat acrid, bitter taste (Strecker). Reddens litmus strongly (L. Gmelin; Strecker). — Rotates a ray of polarised light to the right; in alcoholic solution $[\alpha]D = 29°$ (as determined for Fraunhofer's line D): the rotatory power is not affected by dilution, but is diminished by neutralising the solution with soda-ley (Hoppe-Seyler).

	Needles dried at 100°.		Strecker. *mean* (6).	Mulder. *mean* (3).	Rost van Tonningen.
52 C	312	67·10	67·05	66·70	66·45
N	14	3·01	3·23	3·25	
43 H	43	9·25	9·32	9·27	9·15
12 O	96	20·64	20·40	20·78	
$C^{52}NH^{43}O^{12}$	465	100·00	100·00	100·00	

According to Mulder $C^{54}NH^{44}O^{13}$.

Decompositions. 1. Glycocholic acid *heated* above 100° gives off water and melts to colourless glycocholonic acid (Strecker, *Handwörterb.* [2] 2, 2, 1192). — 2. It yields by *dry distillation* a large quantity of brown empyreumatic oil, and pale-yellow alkaline water. In the open fire it melts to a brown oil, emitting a smell of burnt horn, and afterwards an aromatic odour, and burns with a smoky flame. — 3. It dissolves easily and abundantly in fuming *nitric acid*, evolving a large quantity of gas: the yellow solution throws down, on addition of water, white flocks, a solution of which in aqueous ammonia is not precipitated by lime-water (Gmelin).

4. Glycocholic acid dissolves freely in *oil of vitriol* and in strong *hydrochloric acid*, forming solutions from which it is precipitated unaltered by water. The solutions become turbid on standing or when boiled, from separation of products which are formed from glycocholic acid by elimination of water, and are converted into glycocoll and choloïdic acid by continued boiling. The latter body is further transformed into dyslysin. The product first formed is glycocholonic acid (p. 62); after boiling a few minutes longer, the resin produced contains 72·6 p. c. C., and 9·1 H., corresponding to the formula $C^{52}NH^{39}O^{8}$, so that glycocholic acid loses 2 atoms of water twice in succession (Strecker).

Glycocholic acid, or its soda-salt, when heated with oil of vitriol, runs together into a colourless resin, which slowly dissolves with saffron-yellow colour, changing to red or brown-red on warming: the solution mixed with water deposits white, green, or brown flocks according to the temperature at which the solution was effected. If the resin produced by oil of vitriol be rinsed with water, without entirely removing the acid, and then heated till it becomes coloured, it absorbs oxygen and afterwards yields with alcohol a green solution, which when evaporated, with constant stirring, leaves a deep indigo-coloured residue (Frerichs & Städeler, *Müller's Arch.* 1856, 55; *Kopp's Jahresber.* 1256, 710). Neukomm (*Ann. Pharm.* 116, 30) and Enderlin (*Ann. Pharm.* 75, 174) made similar observations. This residue dissolves in alcohol, forming a gall-green solution. It is coloured yellow or orange by alkalis, green by hydrochloric acid, and deep-green, changing to blue or greenish-brown, red, and dirty-yellow, by nitric acid

and the residue is dissolved in absolute alcohol and mixed with ether, whereupon radiated groups of white needles quickly appear (Strecker). The salt exerts a right-handed action on polarised light; [α]D in aqueous solution = 20·8°, in alcoholic solution = 25·7° (Hoppe-Seyler). — It melts when heated, and burns with smoky flame, leaving carbonate and cyanate of soda. — Dissolves very easily in water, and is precipitated by excess of soda-ley as an amorphous soft resin. Soluble in 27·2 parts of absolute alcohol at 15°, from which it is deposited in crystals by very slow evaporation, otherwise as an amorphous mass (Strecker). Ether throws down from the alcoholic solution an amorphous precipitate, in the absence of water; but if the solution be first mixed with sufficient ether to produce a strong turbidity, and then with water till the turbidity disappears, crystals quickly make their appearance (Städeler, *J. pr. Chem.* 72,257; *Kopp's Jahresber.* 1857, 562).

			Strecker. *mean, at* 100°.	Mulder. *at* 130°.
52 C	312	64·06	63·11	64·1
N	14	2·87		
42 H	42	8·62	8·74	8·7
11 O	88	18·09		
NaO	31	6·36	6·14	6·3
$C^{52}NH^{42}NaO^{12}$	487	100·00		

According to Strecker, the salt dried at 100° is anhydrous, but according to Mulder it loses 2·47 p. c. of water between 110° and 130°.

Acid? — When carbonate of soda is added to glycocholic acid to slightly acid reaction, the solution evaporated, and the residue exhausted with absolute alcohol, there crystallises out, according to Mulder, an acid salt, which, after drying at 100°, loses 1·6 p. c. of water at 130° and then contains 4·5 p. c. of soda.

Glycocholate of Baryta. — Obtained by dissolving glycocholic acid in baryta-water, removing excess of baryta by means of carbonic acid, and evaporating. — Amorphous white mass, soluble in 6·24 parts of water at 15°, less freely in absolute alcohol, from which it does not crystallise (Strecker). — After drying at 100°, it loses 0·8 p. c. water at 120 — 130° (Mulder).

	at 100°.		Strecker. *mean.*	Mulder.
52 C	312	58·60	58·27	58·6
N	14	2·63		
42 H	42	7·88	8·06	8·0
11 O	88	16·54		
BaO	76·4	14·35	14·35	14·1
$C^{52}NH^{42}BaO^{12}$	532·4	100·00		

The glycocholates do not precipitate salts of *strontia, lime,* or *magnesia* (Strecker).

Glycocholate of Lead. — Neutral acetate of lead produces no precipitate in cold aqueous glycocholic acid: the basic acetate occasions slight turbidity. The neutral acetate throws down flocks from the neutral salts, but a small portion still remains in solution and may be precipitated by the basic acetate (Gmelin; Strecker). — The salt is

	Laminæ at 100°.		Strecker. *mean.*	Mulder. *at* 130°.
52 C	312	67·10	67·30	66·7
N	14	3·01	2·73	3·5
43 H	43	9·25	9·28	9·2
12 O	96	20·64	20·69	20·6
$C^{52}NH^{43}O^{12}$	465	100·00	100·00	100·0

Glycocholonic Acid.

$$C^{52}NH^{41}O^{10} = C^{4}NH^{3}O^{2},C^{48}H^{38}O^{8}.$$

STRECKER. *Ann. Pharm.* 67, 20; 70, 166.
MULDER. *Scheik. Onderz.* 5, 51.

Cholonic acid.

The first product of the action of acids on glycocholic acid, afterwards breaking up into choloïdic acid and glycocoll (Strecker).

Preparation. 1. When a solution of glycocholic acid in strong hydrochloric or sulphuric acid is heated, there separate, on cooling, oily drops of glycocholonic acid, which afterwards solidify. The product is purified by dissolving it in aqueous ammonia, precipitating with chloride of barium, and decomposing the precipitate with dilute hydrochloric acid (Strecker). — 2. Ox-gall freed from mucus is precipitated with neutral acetate of lead; the washed precipitate is suspended in water and decomposed by hydrosulphuric acid; the sulphide of lead is washed with cold water; and the acids thrown down with it are extracted by boiling water. The sulphide of lead remaining undissolved gives up to alcohol, glycocholonic acid, which is at once deposited in crystals, together with an amorphous mass, on addition of a little water. The crystals are separated from the amorphous sticky mass, dissolved in alcohol, and precipitated with water. The product still contains paraglycocholic acid and ammonia, from which it is freed by treating it with baryta-water, separating the insoluble glycocholonate of baryta from the soluble glycocholate, and decomposing with hydrochloric acid (Mulder). Since the lead precipitate of ox-gall contains chloride of lead, the subsequent treatment with hydrosulphuric acid sets free hydrochloric acid, which converts glycocholic into glycocholonic acid (Strecker).

Properties. Translucent, highly lustrous needles, or amorphous colourless resin. Has an acid reaction (Mulder).

	at 120°—130°.		Strecker. Amorphous.	Mulder. Needles. *mean.*
52 C	312	69·82	70·54	69·45
N	14	3·13		3·30
41 H	41	9·15	9·46	9·42
10 O	80	17·90		17·83
$C^{52}NH^{41}O^{10}$	447	100·00		100·00

Mulder's formula is $C^{54}NH^{42}O^{11}$.

Decomposition. 1. Dry taurocholic acid is decomposed only at temperatures considerably above 100° (Parke). According to Heintz, it is not completely soluble in water after being heated to 100°; the aqueous and alcoholic solutions also undergo decomposition, and turn milky when evaporated with the aid of heat (Strecker. Heintz). — 2. Taurocholic acid breaks up into cholic acid and taurine when boiled for four hours with *baryta-water:*

$$C^{52}NH^{45}S^{2}O^{14} + 2HO = C^{4}NH^{7}S^{2}O^{6} + C^{48}H^{40}O^{10} \text{ (Strecker).}$$

The same decomposition is effected by heating the acid to 100° with water in a sealed tube (Parke).

This property of taurocholic acid was established by experiments with an acid containing glycocholic acid, and not with the isolated acid. When purified bile is precipitated with neutral acetate of lead, and the precipitate containing glycocholate of lead is removed, basic acetate of lead throws down from the filtrate a mixture of basic glycocholate and taurocholate of lead, containing varying quantities of oxide of lead, carbon, and hydrogen. When the precipitate is decomposed by boiling baryta-water, the filtrate boiled with excess of baryta-water for twenty-four hours, and the residue freed from excess of baryta by means of carbonic acid, a filtrate is obtained, from which hydrochloric acid throws down cholic acid. This filtrate freed from baryta by sulphuric acid, from sulphuric and hydrochloric acids by hydrated oxide of lead, and from lead by hydrosulphuric acid, leaves on evaporation taurine, together with glycocoll, arising from the decomposition of glycocholic acid (Strecker).

3. A solution of the taurocholate of an alkali, mixed with excess of *acid*, becomes turbid on boiling, from separation of choloidic acid, the solution then containing taurine (Strecker). — 4. *Ozone* does not act upon aqueous taurocholates of the alkalis, but oxidizes them completely after addition of excess of alkali, forming carbonic and sulphuric acids, but neither taurine nor bile-acid. Taurocholates of the alkalis, mixed with glycocholates, behave in a similar manner (v. Gorup-Besanez, *Ann. Pharm.* 110, 86; 125, 218).

5. Taurocholic acid, heated with *oil of vitriol* behaves like glycocholic acid (p. 58); when mixed with *oil of vitriol* and *sugar*, it assumes a violet-red colour (Pettenkofer's *bile-test*). Ox-bile, mixed with not too much sugar, and then with oil of vitriol till the precipitate formed at first is dissolved, yields a deep violet liquid resembling the aqueous solution of permanganate of potash. This coloration is obtained also with decolorized bile (Pettenkofer, *Ann. Pharm.* 52, 90).

In testing for bile, the liquid to be examined is mixed with two-thirds of its volume of oil of vitriol, in such a manner that the temperature does not rise above 60°, and the mixture is shaken with 2 to 5 drops of a solution of cane-sugar, whereupon the violet colour appears, provided that the temperature has not been allowed to rise too high, and that neither albumin, nor a large quantity of metallic chlorides, nor too much sugar is present. Hydrochloric acid acts in a simi[illegible] to [illegible] of vitriol, but the colour produced is less intense (Pettenkofer). — [illegible] stituents of bile yield this coloration, which, however, is produ[illegible] tion of sugar, on mixing bile with oil of vitriol, and dropping wa[illegible] (van der Brock, *J. pr. Chem.* 39, 363). When inspissated bile is [illegible] of vitriol, and water is dropped into the mixture, there is produ[illegible] addition of sugar, a violet-red coloration, changing to da[illegible] (Vogel, jun., *N. Jahrb. Pharm.* 3, 150). See also xv.

yellow, friable, very hygroscopic gum, which, according to Strecker, is taurocholate of soda. — Exerts a dextro-rotatory action on polarised light: [α]D for the soda-salt dissolved in water = 21·5°, for the salt dissolved in alcohol = 24·5° (Hoppe-Seyler).

	Dried at 120° to 130°.			Schlieper.	Strecker.
52 C	312	58·10		58·13	58·2
N	14	2·60		3·41	
44 H	44	8·19		8·51	8·2
13 O	104	19·36		18·69	
2 S	32	5·98		6·23	5·9
NaO	31	5·77		5·03	5·8
$C^{52}NH^{44}NaS^{2}O^{14}$	537	100·00		100·00	

The substances formerly described as *purified bile, crystallised bile, soda-salt of bile-acid*, are mixtures of taurocholate and glycocholate of soda, containing also potash and ammonia. Platner (*Ann. Pharm.* 51, 105; 59, 311), gave directions for the preparation of these crystals, agreeing in part with those above given (p. 57). Verdeil (*Ann. Pharm.* 59, 311) analysed the crystals obtained from ox-bile. Bensch (*Ann. Pharm.* 65, 194), analysed the purified bile of the calf, sheep, bear, fowl, fish, and goat; Strecker that of various fishes. All these mixtures contain 52 atoms of carbon and 43 to 44 atoms of hydrogen to 1 atom of base (Strecker).

Taurocholate of Baryta. — Obtained by neutralizing the acid with hydrate of baryta, evaporating over the water-bath, dissolving the residue in absolute alcohol, and mixing it with a small quantity of ether, whereupon the salt is thrown down as a resin, afterwards becoming crystalline (Lieberkühn).

The taurocholates of the alkalis do not precipitate salts of *baryta*, *lime*, or *magnesia*, even after addition of ammonia (Strecker).

Taurocholate of Lead. — Neutral acetate of lead does not precipitate taurocholate of soda: the basic acetate produces white flocks, which dissolve in a large excess of the precipitant and also on boiling, reappearing as the liquid cools. — After filtering from the lead precipitate, ammonia throws down a further quantity, but even then a large quantity of taurocholate remains in solution (Strecker).

The precipitates thrown down by basic acetate of lead from purified ox-bile, and analysed by Theyer and Schlosser, Verdeil, Strecker, and Mulder, were mixtures of taurocholate and glycocholate of lead (Strecker).

Taurocholates of the alkalis precipitate from *acetate of copper*, after addition of ammonia, bluish-white flocks, which dissolve in a larger quantity of ammonia (Strecker). The copper-salt dissolves in water less easily than in alcohol, and is therefore precipitable from aqueous, not from alcoholic solutions (Lieberkühn). — Taurocholates of the alkalis give with alcoholic *ferric chloride* a precipitate which disappears on further addition of the iron-salt. *Stannous chloride* and *mercurous nitrate* throw down white flocks. *Mercuric chloride* produces no precipitate. *Nitrate of silver* does not precipitate the solutions, even after addition of ammonia, but reduces them on boiling (Strecker).

Taurocholic acid dissolves easily in *alcohol*, slightly in *ether* (Strecker).

Biliary Acid from Guano.

F. HOPPE-SEYLER. *Virchow's Archiv.* 26, 525; *Chem. Centr.* 1863, 755; *Kopp's Jahresber.* 1863, 654.

Occurs in Peruvian guano. The same or a similar acid occurs in pigeon's dung.

An extract of guano, made with cold water, is evaporated, till the oxalate of ammonia crystallises, and afterwards precipitated with hydrochloric acid. After standing for some time, the precipitate is collected, washed, and dissolved in alcohol, and the solution, after being decolorised, is evaporated, with addition of carbonate of soda. The residue is exhausted with absolute alcohol, and the extract is freed from alcohol, dissolved in water, and precipitated with chloride of barium. From this precipitate the acid is separated by hydrochloric acid.

The acid does not crystallise. It has an acid reaction, and does not rotate a ray of polarised light. It is free from sulphur, and when pure probably free from nitrogen. — When *heated* it burns with aromatic odour. With *oil of vitriol* and *sugar* it gives the violet-red colour of the bile-acids. Oil of vitriol dissolves it, forming a green fluorescent solution. It is decomposed by boiling with *hydrochloric acid*, yielding a product resembling dyslysin.

The acid is insoluble in *water*, but easily soluble in aqueous *ammonia* and *alkalis*. — The baryta-salt dissolves in hot water, and is deposited in the form of a resin on evaporating the solution. It contains 70·9 p.c. C., 8·2 H., 0·5 N., and 12·7 Ba, or 44 atoms of hydrogen to 32 atoms of carbon. — The acid dissolves in *alcohol*, from which it is precipitated by water and by ether.

Appendix to Bile-acids.

Bile-pigments.

THÉNARD. *Traité de Chimie.* ed. 4, 4, 580.
CHEVREUL. *Majendie J. de Physiol.* 4, 259. — *Ann. de Mus.* 1825, 378.
L. GMELIN. *Tiedemann u. Gmelin, Die Verdauung*, 1, 79.
BOILE. *Br. Arch.* 38, 266.
BERZELIUS. *Lehrbuch*, 3 Aufl. 9, 281. — *Ann. Pharm.* 43, 53.
PLATNER. *Ann. Pharm.* 51, 110.
SCHERER. *Ann. Pharm.* 53, 383.
BRANDES. *Zeitschr. für rationelle Medicin*, 4, 193.
SCHEID (u. WACKENRODER). *N. Br. Arch.* 41, 291 and 294.
HEIS. *J. pr. Chem.* 40, 47; *Kopp's Jahresber.* 1847 and 1848, [illegible]
HEINTZ. *Pogg.* 84, 106; *Kopp's Jahresber.* 1851, 605.
BRÜCKE. *J. pr. Chem.* 77. 22; *Chem. Centr.* 1859, 248; *Kopp[illegible]ber.* 1859, 637.
MALY. *Wien. Akad. Ber.* 49, 498; *Krit. Zeitschr.* 7, 656; *A[illegible]* 132, 127; *Chem. Centr.* 1865, 75; *Kopp's Jahresber.* [illegible] *further J. pr. Chem.* 104, 28; *Jahresb.* 1868, 824.

STÄDELER. *Ann. Pharm.* 132, 323; *Par. Soc. Bull.* 1864, 57; *Kopp's Jahresber.* 1864, 657.—Further: *Epistolary Communication.*
THUDICHUM. Tenth report of the Medical Officer of the Privy Council, p. 240; *J. pr. Chem.* 104, 193; abstr. *Krit. Zeitschr.* 11, 555; *Chem. Centr.* 1868, 609; *Bull. Soc. Chim.* [2] 10, 498; *Jahresb.* 1868, 826.
JAFFÉ. *J. pr. Chem.* 104, 401; *Zeitschr. f. Chem.* [2], 5, 666.

In the bile of the higher classes of animals, more abundantly in certain gall-stones, also in jaundiced urine, and in the serum of blood and chyle, there exist colouring matters, which, when their solutions are mixed with nitric acid [nitrous acid according to Millon (*Compt. rend.* 14, 904)] exhibit a change of colour from green to blue, violet, red, and finally yellow: Gmelin's *Pigment reaction.*

Calculi consisting of bile-pigments are brown, crumbly, and ochry, and evolve an animal odour when burnt. They are only slightly soluble in water and alcohol, but dissolve in potash with dark-brown colour. Nitric acid produces the pigment-reaction.—When burnt they leave a large quantity of ash, which contains carbonate of lime, the lime occurring in the concretion partly as carbonate (Bolle; Scherer) and partly as a compound of lime and colouring matter (Heintz), which is insoluble in alcohol (Bramson).—After exhaustion with water, alcohol, and ether, the pigment gall-stones contain 74 p.c. C., 6·3 H., and 14·4 N., besides ammonia and carbonic acid in the mineral substance. When the latter are removed by means of hydrochloric acid, the residual pigment contains 62·49 p.c. C., 8·17 N., 6·15 H., and 23·18 O. (Scherer), but it is still a mixture, containing, besides pigment, epithelium and other bodies (Heintz).

The pigment of ox gall-stones is Gmelin's *bile-brown*, which passes into *bile-green* when exposed to the air in alkaline solution (Gmelin). The yellow pigment of human gall-stones forms the *cholepyrrhin* of Berzelius, who obtained from inspissated ox-gall a pigment which differed from cholepyrrhin, and to which he gave the name *bilifulvin* when in combination with bases (lime, soda) and *bilifulvic acid* in its isolated condition.

Virchow (*Ann. Pharm.* 78, 352) found crystals of bilifulvin in unhealthy bile and liver, and compared them with hæmatoïdin, from which, however, they were found to differ. Valentiner (*Günzburg's Zeitschr., J. pr. Chem.*, 77, 22) subsequently found that chloroform extracts bile from gall-stones; from jaundiced liver and many other tissues, crystals which give the pigment reaction with nitric acid. These crystals were regarded by Valentiner as identical with hæmatoïdin. Städeler (*Ann. Pharm.* 116, 29), however, showed that hæmatoïdin behaves differently with nitric acid, and possesses a different crystalline form. Jaffé, on the other hand, affirms the identity of bilifulvin with hæmatoïdin, on the ground of the following experiment.

An apoplectic clot containing a large quantity of crystals of hæmatoïdin, was dried, comminuted, moistened with absolute alcohol, and exhausted with chloroform, which, when evaporated in the dark, left golden-yellow crystals of hæmatoïdin. These crystals, after washing with ether, which partially dissolved them, dissolved in aqueous carbonate of soda, with yellow colour, turning green in the air, and gave the pigment-reaction with nitric acid (Jaffé, *Archiv. Pathol. Anat. und Physiol.* 23, 192; *Anal. Zeitschr.* 1, 259).—See also *Handbuch*, viii, 64.

Städeler obtained from human gall-stones, by Valentiner & Brücke's

Decompositions. Alcoholic laserpitin turns brown when heated with strong *potash-ley*, and breaks up into laserol and angelic acid.

$$C^{48}H^{36}O^{14} + 2HO = C^{28}H^{22}O^{8} + 2C^{10}H^{8}O^{4}.$$

If the solution be heated till the whole of the alcohol is expelled and then mixed with an excess of dilute sulphuric acid, brown resinous flocks are deposited, of which a further quantity is obtained on distilling off the angelic acid. These flocks dissolve in alcohol with red-brown colour, and are deposited from the solution on evaporation in yellow amorphous grains, which afterwards become crystalline and cannot be decolorised by animal charcoal. They taste acrid and peppery, dissolve in alcohol and ether, and form with potash-ley a yellow solution, from which acids throw down an amorphous precipitate. This body is Feldmann's *laserol*. After drying over oil of vitriol it contains 65·85 p. c. C., and 8·76 H., corresponding to the formula $C^{28}H^{22}O^{8}$ (calc. 66·14 p. c. C., 8·66 H.).

Laserpitin heated with *caustic potash* evolves an odour of mint. — It is not affected by dry *hydrochloric acid gas*. When heated to 150° with fuming hydrochloric acid, it is partially dissolved, with cherry-red colour, the residue melting to a brown resin. Dilute sulphuric likewise effects no splitting up of the body, even at 250°. — Its cherry-red solution in *oil of vitriol* and the solution in fuming *nitric acid* yield white precipitates on addition of water.

Laserpitin is insoluble in cold and boiling *water*, in dilute and strong *acids*, including glacial acetic acid, and in aqueous *ammonia*, *potash* and *soda*.

It dissolves in 12·34 parts of *bisulphide of carbon*, easily in *chloroform*, in 9 parts of absolute *alcohol*, in 21·73 parts of 85 p. c. alcohol, and in 3·6 parts of *ether*. When rapidly evaporated, these solutions leave amorphous laserpitin, which melts more easily than the crystallised substance, and is more readily dissolved. The alcoholic solution is rendered milky by water, and deposits microscopic crystals, which combine in curdy masses when shaken. The alcoholic solution is not precipitated by iodide of potassium, neutral acetate of lead, corrosive sublimate, or nitrate of silver.

Laserpitin dissolves easily in *benzene*, *oil of turpentine*, and *fat oils*.

2. Coniferin.

$$C^{48}H^{32}O^{24}.$$

W. Kubel. *J. pr. Chem.* 97, 243.

Discovered by Th. Hartig; investigated by Kubel. — Occurs in the cambium of pine and fir trees, more especially the following: *Abies excelsa* and *A. pectinata*, *Pinus Strobus*, *P. Cembra*, *Larix europea*.

Preparation. From the cambium obtained from trees felled and peeled at the time of the formation of new wood. The cambium is scraped off the surface of the wood, and the scrapings are pressed.

The sap is heated to boiling, and filtered to separate coagulated albumin and other substances; the filtrate is evaporated down to ⅛th; and the crystals which form after cooling are purified by recrystallisation from boiling water and weak spirit, with the help of animal char-

with a little water and decomposed by digesting its alcoholic solution with carbonate of baryta. The resulting precipitate contains sulphate and carbonate of baryta, and solanidine, the last of which is extracted from the washed and dried mixture by boiling absolute alcohol. The alcoholic solution, when cooled and concentrated, deposits the solanidine, first in white, afterwards in yellowish crystals, which are separated from any undecomposed solanine by dissolving them in ether, and purified by recrystallisation from ether (Zwenger & Kind). — Or, solanine is decomposed by boiling with dilute hydrochloric acid; the hydrochlorate of solanidine which separates is purified by dissolving it in alcohol and precipitating with ether; an alcoholic solution of the purified salt is decomposed with ammonia, and the precipitate is crystallised from alcohol and ether (Zwenger & Kind).

When dilute acids are employed for the extraction of solanine, the crude product leaves a crystalline residue of hydrochlorate of solanidine, on treating it with hydrochloric acid (O. Gmelin).

Properties. Long, colourless, very delicate silky needles, or, as occasionally obtained from ether, shorter four-sided prisms. It does not undergo alteration at 100°, but melts at 200° [a little above 200° (Kromayer)] to a yellowish mass, which solidifies in radiated crystals. At a higher temperature it sublimes, leaving very little charcoal. Its alcoholic solution is bitter and acrid, but the solid substance is nearly tasteless. — It is more strongly alkaline than solanine.

	Dried in a vacuum.			O. Gmelin.	Zwenger & Kind. *mean.*
50 C	300		81·30	82·00	80·92
N	14		3·77		3·79
39 H	39		10·59	10·71	11·15
2 O	16		4·34		4·14
$C^{50}NH^{39}O^{2}$	369		100·00		100·00

O. Gmelin's solanidine turned yellow at 100°, and was therefore impure. On the formula of solanidine, see *Solanicine* and *Solanine.*

Decompositions. 1. Solanidine slowly *heated* to 200° acquires a yellow or reddish colour. — 2. Cold strong *nitric acid* converts it into a red oil; the hot acid dissolves and oxidises it with violence. — 3. *Oil of vitriol* colours solanidine red, and afterwards dissolves it to a dark-red liquid, with formation of sulphate of solanicine and modified solanidine (p. 88), which substances are precipitated by water, or when formed with oil of vitriol containing water, are slowly deposited as a yellow precipitate. — 4. Solanidine is not affected by boiling strong *potash-ley*, or by *cuprate of potash*, *nitrate of silver*, or *chloride of gold* (Zwenger & Kind). — 5. On dropping *iodine-water* into alcoholic solanidine, the solution is first decolorised and afterwards deposits yellowish-brown flocks (Kromayer).

Solanidine is very slightly soluble in boiling *water.* — It forms with *acids*, neutral and acid salts, which are mostly uncrystallisable. Their solutions are precipitated by ammonia and the fixed alkalis, the solanidine being thrown down in the form of a white jelly. The mono-acid salts have a faintly acid reaction and a bitter acrid taste, and dissolve with difficulty in water and aqueous acids (Zwenger & Kind).

matter. The residue is purified by dissolving it in common vinegar, neutralising the solution with ammonia, and boiling. The precipitate is collected, washed, powdered, and boiled for a few minutes with 60 times its weight of 85 p. c. alcohol. The pale-brown liquid, filtered while hot, solidifies to a jelly on cooling, whilst the residue on the filter, when again boiled with an equal quantity of alcohol, yields a colourless filtrate, which deposits crystals on standing for a few minutes. The jelly first obtained is washed with ammonia-water so long as the liquid is coloured, then heated to boiling with alcohol, and allowed to cool on a sand-bath heated to 50°. The crystals of solanine deposited after standing for 24 hours, together with those previously obtained, are purified by washing with alcohol (Reuling; Zwenger & Kind).—2. Fresh shoots, whole, are digested for 24 hours in water acidified with sulphuric acid, the liquid is decanted, and the now tasteless residue is pressed. The liquid thus obtained is concentrated by digesting in it a fresh portion of the shoots, then strained, and mixed with hydrate of lime to alkaline reaction. The precipitate thereby produced is dried and powdered, and the solanine is extracted from it by repeated boiling with alcohol (Wackenroder). Baumann employs hydrochloric instead of sulphuric acid. If the lime be cautiously added, so that in the first place only the free acid is neutralised, the precipitate afterwards formed is nearly free from sulphate of lime (Meurer, *N. Br. Arch.* 40, 276).

3. The fresh shoots, bruised, are exhausted with hot water containing sulphuric acid; the extract is precipitated with neutral acetate of lead; excess of lead is removed by means of sulphuric acid; and the hot filtrate is precipitated with milk of lime. From this precipitate the solanine is extracted by repeated boiling with alcohol, the crystals deposited from the first decoction being less pure than those obtained afterwards (Otto). In this way Otto obtained in his earlier experiments crystallised solanine, but subsequently only a gelatinous solanine, which could not be made to crystallise. According to Reuling, however, the conversion of the jelly into crystals is effected by washing with aqueous ammonia; and, according to Wackenroder, by dissolving the jelly in sulphuric acid and precipitating with lime.

Inasmuch as solanine prepared with acids may contain solanidine, it must be purified by dissolving it in cold, moderately strong hydrochloric acid, which leaves solanidine undissolved as hydrochlorate (Zwenger & Kind). Or solanine, free from solanidine, may be obtained by beating potato-shoots to a pulp, expressing, precipitating the liquid with milk of lime, and exhausting the precipitate with boiling alcohol. By exhausting the expressed shoots with water containing sulphuric acid, a gelatinous mixture of solanine and solanidine is obtained, from which solanidine may be prepared by boiling with hydrochloric acid (Kromayer).

Desfosses precipitates the filtered juice of the berries of *Solanum nigrum* with ammonia, washes the grey precipitate with cold water, boils it with alcohol, and obtains the solanine partly by cooling, partly by evaporating the alcoholic liquid.—Payen & Chevallier boil the bruised dry berries of *Solanum verbascifolium* with alcohol, evaporate the decoction, dissolve the extract in water, wash the resin which separates, and precipitate the solanine from the aqueous liquid by digesting it with magnesia. From this precipitate the solanine is extracted by boiling alcohol.—Heintz exhausts the powdered stalks of bitter-sweet with alcohol containing sulphuric acid, digests the tincture with lime, filters, distils off the alcohol, washes the residue with water,

A. *Mono-acid.* — Obtained by adding excess of solanine to a solution of B in cold water, and evaporating in a vacuum. — Colourless gum, of faint acid reaction, decomposed by water with separation of solanine (Zwenger & Kind).

	Dried at 100°.		Zwenger & Kind.
86 C	516	57·08	57·13
N	14	1·54	1·27
70 H	70	7·74	8·16
33 O	264	29·20	28·77
SO^3	40	4·44	4·67
$C^{36}NH^{69}O^{32},HO,SO^3$	904	100·00	100·00

B. *Bi-acid.* — Precipitated by ether from a solution of solanine in alcohol containing sulphuric acid, in the form of a white jelly. — Amorphous, transparent, strongly acid mass, easily soluble in water, and not decomposed by boiling water (Zwenger & Kind).

	Dried in a vacuum.		Zwenger & Kind.
86 C	516	54·14	53·68
N	14	1·47	
71 H	71	7·45	8·00
34 O	272	28·54	
2 SO^3	80	8·40	8·78
$C^{36}NH^{69}O^{32},2(HO,SO^3)$	953	100·00	

Iodide of potassium throws down a crystalline precipitate from sulphate of solanine, after some hours only (Otto). — Solanine crystallises unaltered from aqueous *perchloric acid* (Bödeker).

Hydrochlorate of Solanine. — One hundred parts of solanine take up 4·23 parts of hydrochloric acid gas (Blanchet) (? 1 at. = 4·27 parts HCl); 12·2 parts of hydrochloric acid, but the product is coloured (O. Gmelin). — The salt is obtained by precipitating with ether a solution of solanine in alcohol containing hydrochloric acid, and freeing the precipitate from excess of acid by repeatedly dissolving it in alcohol and precipitating with ether. — Gelatinous precipitate, which dries up to a colourless, transparent, friable gum. — Decomposed with difficulty by boiling with water (Zwenger & Kind).

	Dried in vacuum.		Zwenger & Kind.
86 C	516	57·88	57·86
N	14	1·56	1·30
70 H	70	7·85	8·39
32 O	256	28·74	28·35
Cl	35·5	3·97	4·10
$C^{36}NH^{69}O^{32},HCl$	891·5	100·00	100·00

Solanine forms no salt with *nitric acid*, on account of its being decomposed thereby (Baumann).

Chromate of potash throws down from sulphate of solanine a yellowish precipitate (Otto). — *Phospho-molybdic acid* precipitates solanine lemon-yellow and pulverulent (Sonnenschein; O. Gmelin). — Solanine dissolves in aqueous *ferric chloride*, without affecting the yellow colour (Henmann). — *Stannous chloride* throws down from sulphate of solanine a white jelly; *sulphate of copper* a slight bluish-white pulverulent pre-

cipitate (Baumann). — *Mercuric chloride* produces a white precipitate in sulphate of solanine (Otto), but not in the hydrochlorate (v. Planta); *mercuric nitrate* gives a white crystalline precipitate (Baumann). *Iodomercurate of potassium* throws down white slimy flocks from hydrochlorate of solanine (v. Planta, Delffs).

Chloroplatinate of Solanine. — Obtained by adding excess of bichloride of platinum to a solution of solanine in alcohol containing hydrochloric acid, precipitating with ether, and purifying the precipitate from adhering chloride of platinum by oft-repeated solution in alcohol and precipitation with ether. — Faint yellow flocks, which dry up in a vacuum to a dark-yellow, amorphous, transparent, hygroscopic mass. Slightly acid; easily soluble without decomposition in boiling water, and more freely in alcohol (Zwenger & Kind).

	Dried at 100°.		Zwenger & Kind.
86 C	516	48·62	48·10
N	14	1·31	1·26
70 H	70	6·59	7·25
32 O	256	24·14	
3 Cl	106·5	10·03	
Pt	98·7	9·31	9·40
$C^{86}NH^{69}O^{32},HCl,PtCl^2$	1061·2	100·00	

Solanine is not precipitated by *terchloride of gold*, or by *chloride of iridium and sodium* (v. Planta).

Formate and *hydrocyanate of solanine* are amorphous, gummy substances, decomposible by water. The hydrocyanate is sparingly soluble in water (Baumann). — *Ferrocyanide of potassium* precipitates a white powder from sulphate of solanine on standing (Otto). *Sulphocyanide of potassium* throws down yellowish flocks from concentrated hydrochlorate of solanine (v. Planta). — Hydrochlorate of solanine forms no compound with *mercuric cyanide* (Kohl & Swoboda).

Acetate of Solanine. — The easily formed solution of solanine in acetic acid gives off acetic acid on exposure to the air, even when saturated as fully as possible with solanine, leaving a colourless gummy mass, which is no longer quite soluble in alcohol. By evaporating the solution, with repeated addition of water, the whole of the acetic acid is expelled; moreover, ether throws down from the alcoholic solution solanine free from acetic acid (Zwenger & Kind). The neutral solution curdles when evaporated, from the separation of flocks, which re-dissolve on cooling (Heumann).

Oxalate of Solanine. — Oxalic acid produces a crystalline precipitate in sulphate of solanine (Baumann). Oxalate of potash throws down a slight pulverulent precipitate, which afterwards turns crystalline (Otto).

Neutral salt. — When excess of solanine is digested in aqueous oxalic acid, and the filtrate is evaporated in a vacuum, the residue consists of red white crusts, made up of microscopic needles, often accompanied by an amorphous anhydrous salt. The crusts lose 6·16 p. c. of water at 100° (14 atoms = 6·53 p. c. HO). They dissolve easily in cold water, and deposit solanine in boiling water, the base being re-dissolved on cooling (Zwenger & Kind).

Primary Nucleus $C^{50}H^{44}$; *Oxygen-nucleus* $C^{50}H^{38}O^{4}$.

Hyodyslysin.

$$C^{50}H^{38}O^{6} = C^{50}H^{38}O^{4},O^{2}.$$

STRECKER. *Ann. Pharm.* 70, 188.
VAN HEIJNINGEN & SCHARLÉE. *Scheik Onderz.* 5, 130.

Obtained by boiling hyoglycocholic acid with strong hydrochloric acid for some days, or until the oily layer becomes hard and friable. The product is purified by washing it with boiling water, dissolving in ether, and precipitating with alcohol.

It is insoluble in aqueous ammonia, but soluble in alcoholic potash, and is rendered soluble in water by fusion with hydrate of potash.—It is insoluble in cold, sparingly soluble in boiling alcohol; moderately soluble in ether (Strecker).

	Dried at 120°.		Strecker.	Van Heijningen & Scharlée.
50 C	300	77·72	77·61	78·07
38 H	38	9·84	9·97	9·67
6 O	48	12·44	12·42	12·26
$C^{50}H^{38}O^{6}$	386	100·00	100·00	100·00

Homologous, and according to van Heijningen and Scharlée, identical with dyslysin.

Primary Nucleus $C^{50}H^{44}$; *Oxygen-nucleus* $C^{50}H^{40}O^{4}$.

Hyocholic Acid.

$$C^{50}H^{40}O^{8} = C^{50}H^{40}O^{4},O^{4}.$$

AD. STRECKER. *Ann. Pharm.* 70, 191.

Hyocholalic acid (Strecker).—Formed, together with glycocoll, by boiling hyoglycocholic acid with alkalis.—Also by boiling with acids? (Kr.). See below.

A solution of hyoglycocholic acid in dilute potash-ley is boiled for 24 hours, with addition of water sufficient to retain everything in solution; the solution is decomposed with hydrochloric acid, and the resinous hyocholic acid thereby precipitated is washed with water and dissolved in ether. The ethereal solution, when slowly evaporated, deposits the acid in round, white granules, which sometimes crystallise from alcoholic solution in microscopic six-sided tables.

	Dried at 120°.		Strecker. *mean* (4).
50 C	300	74·25	74·27
40 H	40	9·90	10·05
8 O	64	15·85	15·68
$C^{50}H^{40}O^{8}$	404	100·00	100·00

Pig's bile contains, besides the above, a small quantity of an acid containing sulphur, *hyotaurocholic acid* [*hyocholeïc acid* (Strecker)], which is decomposed by evaporating its alcoholic solution, with separation of taurine. This body, which has not been isolated, is probably represented by the formula $C^{54}NH^{45}S^{2}O^{12}$ (corresponding to that of taurocholic acid), and susceptible of being resolved into hyocholic acid and taurine (Strecker). — According to Mulder (*Scheik. Onderz.* 5, 133), pig's bile contains bilin (p. 65), or a similar unstable body, as principal constituent.

The acids of pig's bile exist for the most part in combination with soda, and to a less extent in combination with potash and ammonia (Gundelach & Strecker).

Preparation. A. *Of the Soda Salt.* 1. Fresh pig's bile is digested for some time with Glauber's salt and a small quantity of water. As the Glauber's salt dissolves, hyoglycocholate of soda, colouring matter, and mucus are precipitated. The precipitate is washed with a saturated solution of Glauber's salt by decantation, dried at 100°, and digested with absolute alcohol, which dissolves the hyoglycocholate of soda. The slightly-coloured solution is then decolorised by animal charcoal and mixed with ether, and the precipitate thereby produced is washed with ether, and dried at 100° (Gundelach & Strecker). — 2. Inspissated and powdered pig's bile is digested over the water-bath with absolute alcohol, which leaves mucus undissolved; the tincture is concentrated and placed in the cold; the chloride of sodium which then separates is removed; and the residual solution is decolorised with animal charcoal and mixed with ether, which precipitates hyoglycocholate of soda, whilst cholesterin and fat remain in solution. The resinous precipitate, purified by repeated treatment with ether, still contains chloride of sodium and colouring matter; it is therefore dissolved in cold absolute alcohol, digested with animal charcoal, and again precipitated with ether (Gundelach & Strecker). The product of the second process contains a little potash and ammonia-salt, as well as salt of hyotaurocholic acid.

B. *Separation of the acid from the soda-salt.* — An aqueous solution of the soda-salt is decomposed by hydrochloric or dilute sulphuric acid; the precipitate is dissolved in alcohol and mixed with water, whereby a milky liquid is produced, which deposits oily drops on standing; the liquid is warmed, together with the precipitate, for several days, until the whole of the alcohol is expelled; and the acid thereby precipitated is purified by again dissolving it in alcohol and precipitating with dilute hydrochloric acid (Gundelach & Strecker).

Properties. White, hard, friable resin, melting only above 120°. Has an acid reaction (Gundelach & Strecker). Exerts a slight dextrorotatory action on polarised light $[\alpha]j = 2°$; the soda-salt is optically inactive (F. Hoppe, *Chem. Centr.* 1859, 74).

	Dried at 130°.		Gundelach & Strecker. *mean.*	Strecker	v. Heijningen. & Scharlée.	Gorup-Besanez.
54 C	324	70·28	70·08	70·16	69·66	72·36
N	14	3·04	3·54		4·88	
43 H	43	9·33	9·65	9·21	9·53	9·72
10 O	80	17·35	16·73			17·92
$C^{54}NH^{43}O^{10}$.	461	100·00	100·00			

volume of water at a temperature of 60° to 70°, and more oil of vitriol is added till the mass becomes soft and dark-red. The whole is then mixed with a large quantity of water, and the hydrocarbons thereby precipitated are washed with water and subsequently boiled with ether so long as that liquid continues to take up colouring matter, or to dissolve anything of importance. Beta- and gamma-cholesterilin are thus dissolved, together with a small quantity of alpha-cholesterilin, the principal part of which, however, remains undissolved. The ethereal solution is mixed with alcohol, whereby the cholesterilin is precipitated, whilst unchanged cholesterin remains in solution; the yellow resinous precipitate is dissolved in ether, any residual alpha-cholesterin being separated; and the ethereal solution is allowed to evaporate spontaneously, whereupon it first deposits crystals of beta-cholesterilin, and afterwards a resinous mass of gamma-cholesterilin.

Alpha-cholesterilin. — Whitish-yellow earthy mass, which may be obtained from its solution in turpentine-oil in delicate faintly lustrous crystals. Inodorous and tasteless; lighter than water (Zwenger). The (probably too dilute) solution in coal oil is optically inactive (Hoppe-Seyler). — It turns yellow when heated, melts at about 240°, being for the most part decomposed, and solidifies to a yellow glass on cooling. — In contact with nitric acid it puffs up, and is apparently converted into cholesteric acid (xiii, 157). — It forms with oil of vitriol a soft, brown-red resin, from which it is separated by water nearly unaltered. A solution of this resin in a larger quantity of oil of vitriol is of a dirty dark-green colour by reflected, and dark-brown by transmitted light. — It is decomposed by chlorine.

Alpha-cholesterilin is insoluble in water, and nearly insoluble in alcohol. It dissolves slightly in boiling ether, crystallising on cooling. It is soluble in warm volatile oils.

2. *Beta-cholesterilin.* — Formed only in small quantity. — Highly lustrous white laminæ, or needles. Melts at about 255° to a colourless liquid, which solidifies in a radiated crystalline mass; when slowly heated it is yellow and uncrystallisable, and gives off a volatile oil (Zwenger). Exerts a dextrorotatory action on polarized light (Hoppe-Seyler). — Oil of vitriol converts it into a dark-red resin, a solution of which in excess of sulphuric acid appears of an emerald-green colour, afterwards dark-green by reflected, and dark-red by transmitted light. — It dissolves with difficulty in warm ether, but easily in warm oils, either fixed or volatile.

3. *Gamma-cholesterilin.* — Purified by again dissolving in ether and precipitating with alcohol. — Yellow amorphous resin, or yellowish-white powder, melting at 127°, and solidifying to a brittle glassy mass on cooling (Zwenger). Dextro-rotatory (Hoppe-Seyler). — Yields by dry distillation a volatile oil of aromatic odour. Dissolves with difficulty in alcohol, easily in cold ether, and easily in warm oils, either fixed or volatile.

				Zwenger. *mean.* α.	β.	γ.
52 C	312	88·13	88·05	88·29	87·92
42 H	42	11·87	12·09	12·18	11·99
$C^{52}H^{42}$	354	100·00	100·14	100·47	99·91

liquid is distilled. The red pulpy residue is boiled with alcohol and excess of hydrated oxide of lead, whereby lead-salts of fatty acids are formed, which for the most part remain behind on filtration. The cholesterin crystallises out on cooling, and is purified by again treating its hot alcoholic solution with oxide of lead and recrystallising from alcohol (Müller, *Ann. Pharm.* 105, 363). See also xvi, 480. Beneke obtains cholesterin from yolk of egg in the same manner as from peas.

From dry Peas and other Seeds. The finely pounded seeds are macerated for 48 hours with alcohol mixed with ¼th its volume of ether, and afterwards for 24 hours with alcohol and ⅕th its volume of ether; the extracts are distilled; the residue is suspended in water and shaken with ether; the ethereal layer is separated and distilled; and the residue after boiling for an hour with alcoholic potash, is dried, dissolved in water, and shaken with ether, which takes up cholesterin and a little yellow colouring matter. The product is purified by treating it with weak spirit (Lindenmeyer). Beneke digests 5 pounds of bruised peas for 24 hours in an equal quantity of 94 p. c. alcohol at the temperature of 35°; evaporates the deep-yellow tincture to an extract; boils the extract with 400 cubic centimetres of water and 1 pound of litharge; decants the water; exhausts the lead-precipitate with boiling alcohol; treats the alcoholic liquid with hydrosulphuric acid; then filters and cools, whereupon the cholesterin crystallises. The mother-liquor still contains cholesterin, to obtain which the alcohol is driven off, and the residue boiled for some hours with baryta-water. The flocks thereby formed are separated by filtration and boiled with alcohol. The filtrate deposits, on cooling, crystals of cholesterin, the entire yield of which amounts to 1·5 grammes.

¶ The following process is given by Hoppe-Seyler for the detection and estimation of cholesterin in animal and vegetable tissues and fluids: The substance under examination is repeatedly exhausted with its own volume or several times its volume of ether; the clear decanted or filtered extracts, completely separated from the aqueous solution, are distilled in the water-bath; and the dried residue is weighed. Part or the whole of this residue is then boiled for several hours with a clear concentrated alcoholic solution of potash, and finally the alcohol is evaporated, the residue dissolved in water, and the mobile solution repeatedly shaken up with ether. This ethereal extract contains the cholesterin generally almost pure; in the contrary case, the residue is agitated while yet warm, with dilute potash-ley, and, after cooling, again treated with ether. A small portion of the soaps (produced from saponifiable fats) is then dissolved by the ether, only when there is an insufficient quantity of water and alkali present. By this process the quantities (in grammes) of cholesterin in 100 c.c. of blood were found to be as follows: I and II from very fat young geese, III and IV from a fat old goose, V from an ox.

In the blood-corpuscles.					In the serum.			
I.	II.	III.	IV.	V.	I.	II.	III.	IV.
0·043	0·052	0·040	0·060	0·048	0·234	0·314	0·019	0·035

Hence it appears: 1. That the proportion of cholesterin in the corpuscles is nearly constant, varying only from 0·04 to 0·06 grm. in 100 c.c.;

than water (Chevreul). — It loses the whole of its water over oil of vitriol (Heintz) or at 100°, and also when melted.

	Hydrated.		Pleischl.	Kühn.	Heintz.
$C^{52}H^{44}O^2$	372	95·38			
2 HO	18	4·62	5·2	5·2	4·62 to 5·72
$C^{52}H^{44}O^2 + 2aq.$	390	100·00			

Schwendler and Meissner doubted the presence of water: their cholesterin with 2·83 p. c. of water, crystallised from ether-alcohol, cannot be obtained, and was probably partially effloresced hydrated cholesterin (Heintz).

Cholesterin is insoluble in *water*.—When melted with *phosphorus*, it solidifies to a crystalline mass, and crystallises from alcohol free from phosphorus (Kühn).

Cholesterin-soda. — Rock-oil, previously purified by long standing over sodium, is saturated with dry cholesterin, and pieces of sodium are dropped into the solution, whereupon an evolution of hydrogen takes place and the sodium becomes covered with white crusts. After standing and shaking till the crusts no longer increase, the liquid is filtered, and the solid is pressed between dried blotting-paper and preserved over oil of vitriol. — From a strong solution in hot chloroform or rock-oil, it crystallises in delicate needles. Melts at 150°, and undergoes decomposition at 190°. Decomposed by water and more rapidly by weak spirit (Lindenmeyer).

			Lindenmeyer. *mean.*
52 C	212	79·19	79·20
43 H	43	10·91	11·07
2 O	16	4·06	4·89
Na	23	5·84	4·84
$C^{52}H^{43}NaO^2$	394	100·00	100·00

Cholesterin with Acetic Acid.—Cholesterin dissolves in hot glacial acetic acid, forming a solution which deposits crystals on cooling (Beneke). The saturated solution solidifies, on cooling, to a mass of four-sided, long thin needles, which, after pressing and drying, melt at 110°, and give off 12·7 to 13·7 per cent. of acetic acid. — In alcohol the compound becomes opaque and dissolves, the solution subsequently depositing crystals of cholesterin (Hoppe-Seyler and Zalesky, *J. pr. Chem.* 90, 331). The crystals dried over lime are free from acetic acid (Beneke).

			Zalesky.
$C^{52}H^{44}O^2$	372	86·11	
$C^4H^4O^4$	60	13·89	12·7 to 13·7
$C^{52}H^{44}O^2,C^4H^4O^4$	432	100·00	

Cholesterin dissolves in *butyric* and *valerianic acids* when warmed, and in *caproic* and *caprylic acids* in the cold. The solutions deposit long prisms. It is nearly insoluble in *lactic acid* and in aqueous *oxalic* and *glycollic acids* (Beneke).

Cholesterin dissolves easily in *bisulphide of carbon* (Kühn). — It dissolves so freely in hot *wood-spirit* that the solution solidifies to a crystalline mass on cooling (Gmelin). — It is soluble in 6·65 parts of *chloroform* at 20° (Lindenmeyer). — Dissolves in 16·5 parts of absolute

alcohol at 15°, in 4·9 parts at 34·5°, and in all proportions of the boiling liquid (Kühn). Nearly insoluble in cold aqueous alcohol; soluble in 9 parts of boiling alcohol of sp. gr. 0·84, and in 5·55 parts of sp. gr. 0·816 (Chevreul). The solution deposits most of the cholesterin on addition of water. — Cholesterin dissolves more freely in warm than in cold *ether*; according to Kühn in 12·1 parts of ether at 0°, in 3·7 parts at 15°, and in 2·2 parts boiling.

It dissolves freely in *coal-oil* (Hoppe-Seyler); slightly in boiling *oil of turpentine* (Bostock); as freely in turpentine as in ether (Kühn). *Fat oils* also dissolve cholesterin (Fourcroy & Vauquelin). — It forms a turbid liquid with *soap-water*, and swells up in microscopic myelin-like forms (Beneke). According to Strecker it dissolves in aqueous *taurocholic* and other bile-acids.

Conjugated Compounds of the Primary Nucleus $C^{36}H^{48}$.

Choride of Cholesteryl.

$$C^{36}H^{48}Cl = C^{36}H^{48},HCl.$$

BERTHELOT. *N. Ann. Chim. Phys.* 56, 61.
PLANER. *Ann. Pharm.* 118, 25.

Cholesterine chlorhydrique. Chlorcholesteryl. Cholesterinchlorufer.

1. Cholesterin is heated to 100° with strong hydrochloric acid for eight or ten hours in a sealed tube; the product is washed with water; the portion remaining undissolved is taken up with ether and shaken with weak potash-ley; and the ethereal solution is evaporated. There then remains a neutral translucent resin, which contains hydrochloric acid, but gives up a part of it on purification (Berthelot). — 2. By the action of pentachloride of phosphorus on cholesterin a brown crystalline mass is obtained, which, after pressing and boiling with water, crystallises from alcohol and ether in long needles. The crystals melt at about 100°: appear while cooling of a splendid violet colour by reflected, and yellowish-green by transmitted light; are not decomposed by boiling strong potash-ley; dissolve easily in ether and sparingly in alcohol (Planer).

	Needles.			Planer. *mean.*
52 C	312		79·89	79·75
43 H	43		11·02	11·15
Cl	35·5		9·09	8·83
$C^{52}H^{43}Cl$	390·5		100·00	99·[illegible]

Acetate of Cholesteryl.

$$C^{36}H^{48}O^{4} = C^{36}H^{43}O.C^{4}H^{3}O^{3}.$$

BERTHELOT. *N. Ann. Chim. Phys.* 56, 60.

Cholesterine acetique.

Obtained in the same way as the butyrate, and freed in like manner from excess of acid.

On heating to 100° equal numbers of atoms of cholesterin and glacial acetic acid, 17·5 p. c. is converted into ether in nine hours, and 34·1 p. c. in 40 hours (Berthelot & Péan de St. Gilles, *Compt. rend.* 55, 42).

The compound dissolves in boiling alcohol, and therefore cannot be separated from free cholesterin with certainty.—It yields acetic acid and cholesterin by saponification.

Butyrate of Cholesteryl.

$$C^{60}H^{50}O^4 = C^{52}H^{42}O,C^4H^7O^3.$$

BERTHELOT. *N. Ann. Chim. Phys.* 56, 59.

Cholesterine butyrique.

Cholesterin is heated to 200° with butyric acid for eight or ten hours in a sealed tube. The product is first treated with a strong aqueous solution of carbonate of potash: ether is then added, and the whole is shaken. The ethereal layer is decanted, filtered, decolorised with animal charcoal, and evaporated, when a mixture of free cholesterin and cholesteric butyrate remains, the former of which is removed by repeated boiling with alcohol. The undissolved butyrate may be crystallised from ether.

Neutral colourless crystals, which are easily fusible, and afterwards remain semi-soft and translucent till the mass is nearly cold.

			Berthelot.
60 C	360	81·45	81·9
50 H	50	11·31	11·3
4 O	32	7·24	6·8
$C^{52}H^{42}O,C^4H^7O^3$	442	100·00	100·0

When melted on platinum-foil, it evolves an odour of spice and butyric acid, takes fire, and burns with a red smoky flame.—When submitted to *dry distillation*, it yields acid products.—It is resolved by *alkalis* into cholesterin and butyric acid.

It is nearly insoluble in cold *alcohol*, but dissolves rather more freely than stearate of cholesteryl in boiling alcohol, and very easily in *ether*.

Benzoate of Cholesteryl.

$$C^{66}H^{46}O^4 = C^{52}H^{42}O,C^{14}H^5O^3.$$

BERTHELOT. *N. Ann. Chim. Phys.* 56, 61.

Cholestérine benzoique.

Cholesterin is heated to 200° with benzoic acid for 8 or 10 hours, and

the contents of the tube, intimately mixed with aqueous carbonate of potash by trituration, are shaken with ether (with addition of a little caustic potash, if necessary) till a test-portion of the ether no longer gives up acid to water. The ether is then decanted, filtered, decolorised with animal charcoal, and evaporated. The residue is freed from uncombined cholesterin by boiling it repeatedly with alcohol, and the benzoate is crystallised from ether.

Shining white laminæ, appearing rectangular and thicker than cholesterin under the microscope. Melts at 125° to 130°. Neutral. When carefully heated in small quantity it volatilises without decomposing.

			Berthelot.
66 C	396	83·19	82·6
48 H	48	10·09	10·4
4 O	32	6·72	7·0
$C^{66}H^{48}O,C^{26}H^{24}O^{4}$	476	100·00	100·0

Decompositions. Heated above its melting-point on platinum foil, it evolves a peculiar aromatic odour and *burns* with smoky flame.—Submitted to *dry distillation* in larger quantity, it yields a sublimate of benzoic acid.—It is very slowly resolved into cholesterin and benzoic acid by slaked lime at 100°.

Dissolves very slightly in *alcohol*, even when boiling, but easily in *ether*.

Stearate of Cholesteryl.

$$C^{36}H^{36}O^{4} = C^{36}H^{36}O,C^{36}H^{36}O^{3}.$$

BERTHELOT. *N. Ann. Chim. Phys.* 56, 57.

Cholestérine stearique.—Obtained from cholesterin and stearic acid in the same manner as stearate of cetyl (xvi, 128).

White shining needles. Neutral. Melts at about 65° to a transparent liquid, which solidifies to a dead-white amorphous mass.

	Neelius.		Berthelot.
88 C	528	82·78	82·9
78 H	78	12·22	12·1
4 O	32	5·02	5·0
$C^{36}H^{36}O,C^{36}H^{36}O^{3}$	638	100·00	100·0

Decompositions. Stearate of cholesteryl *heated* on platinum foil evolves aromatic, somewhat agreeably smelling vapours, which burn with a white flame.—By dry distillation it yields an acid product, and leaves no charcoal.—It is resolved into cholesterin and stearate of lime by heating to 100° with slaked lime, the decomposition being completed only in 8 or 10 days.

It is nearly insoluble in *alcohol* either cold or boiling, but easily soluble in cold *ether*.

Appendix to Cholesterin.

1. Ambrein.

Buchholz. *N. Tr.* 18, 1, 28.
John. *Berl. Jahrb.* 1818, 104.
Pelletier & Caventou. *J. Pharm.* 6, 50; *N. Tr.* 4, 2, 333.
Pelletier. *Ann. Chim. Phys.* 51, 188; *Schw.* 67, 84; *Ann. Pharm.* 6, 24.

Amberharz (John). *Amberstoff* (Buchholz). *Amberfett.* — Discovered by Buchholz. — The chief constituent of grey ambergris. The excrement of *Delphinus globiceps* contains a substance which resembles ambrein, but has a higher melting-point (Chevallier & Lassaigne, *J. Pharm.* 7, 279).

Ambergris is boiled with alcohol, and the liquid is filtered, whereupon the ambrein crystallises, and may be purified by pressing and recrystallisation.

White, delicate needles, arranged in tufts. Softens at 25°, and melts at 30° (Pelletier & Caventou). Melts at 36° (Pelletier), at 37·5° (John). Tasteless and inodorous when free from volatile oil; after repeated melting it smells like resin.

According to Pelletier and Caventou, it contains 82·2 p. c. C., 13·3 H., and 4·5 O., from which numbers Berthelot calculates the formula $C^{36}H^{46}O^{2}$ (*N. Ann. Chim. Phys.* 56, 67).

Ambrein heated in a retort turns brown, evolves white vapours, and distils almost entirely unchanged (Pelletier & Caventou). — When heated on platinum foil, it is almost completely volatilised in white fumes (Buchholz). — It turns soft in strong nitric acid, and when heated therewith dissolves, and is converted into ambreic acid, with evolution of nitric oxide (Pelletier & Caventou).

To prepare *ambreic acid*, the solution of ambrein in nitric acid is evaporated to dryness; the residue is washed with cold water; boiled with water and a little carbonate of lead; again washed with water so long as it gives up nitrate of lead; dissolved in boiling alcohol, and filtered. — The acid crystallises in small yellowish-white tables, which redden litmus, and do not melt at 100°. — It dissolves to a very slight extent in water, and is partially deposited from its solution in boiling water as it cools. The neutral potash-salt is easily soluble; the acid salt is precipitated in flocks from an alcoholic solution of the acid by the addition of a little potash. The neutral salt gives dark-yellow precipitates with metallic salts. Ambreic acid dissolves easily in alcohol, less freely in ether (Pelletier & Caventou).

Ambrein is not saponified by boiling for eight hours with strong potash-ley.

It dissolves freely in absolute *alcohol* and does not crystallise on cooling or evaporation (John). The solution in warm weak spirit yields a large quantity of crystals on cooling (Pelletier). — It is easily soluble in *ether*, and in *volatile* and *fixed oils* (Buchholz).

2. Castorin.

Bizio. *Bragn. Giorn.* 17, 174; abstr. *N. Tr.* 11, 1, 200.
Brandes. *Br. Arch.* 16, 281.
Winckler. *Mag. Pharm.* 13, 172.

Castoreum camphor. — Observed by Fourcroy, Bucholz, and Bizio. — Occurs in castoreum, which contains also cholesterin (Brandes, Lehmann), a resin insoluble in ether, and Brandes' castoreum resinoid (*N. Br. Arch.* 1, 183).

Preparation. Castoreum is boiled with 8 parts of alcohol of sp. gr. 0·85, and the solution is filtered and evaporated to one-half. The crystals of castorin thus obtained are washed first with cold alcohol, then with aqueous ammonia or potash, dissolved in alcohol, and decolorised with animal charcoal (Bizio). The alcoholic decoction of castoreum deposits fat on cooling, which may be separated by filtration (Brandes).

Properties. — Castorin crystallises in granules or in tufts of white transparent needles, very light and very friable (Bizio). It melts in boiling water to an oil, which floats on the surface and solidifies to a transparent mass. When boiled with water it volatilises to some extent with the aqueous vapour, so that the distillate turns cloudy after some time (Brandes). It has a faint odour of castoreum and a peculiar taste. Neutral (Bizio).

Decompositions. Castorin yields by dry distillation a pomegranate-yellow oil, which solidifies to a soft resin. — It takes fire, and burns with a bright flame, leaving charcoal. — It is decomposed by prolonged boiling with nitric acid, the decoction yielding on evaporation yellow needles and granules of Brandes' *castoric acid*. — The easily formed solution of castorin in oil of vitriol is perfectly colourless (Brandes); it is of a yellowish-green colour, precipitable by water, and when heated evolves sulphurous acid, with separation of charcoal (Bizio).

Castorin is insoluble in *cold*, and very slightly soluble in boiling *water*, from which it crystallises in a few days (Bizio). — It is soluble, according to Brandes, insoluble according to Bizio, in warm dilute *sulphuric acid*; freely soluble in hot strong *nitric acid* (Bizio), from which it is precipitated by water (Winckler). — According to Bizio, it is insoluble in hot aqueous ammonia, potash, and soda; but according to Brandes it dissolves freely in hot strong potash-ley, and is deposited on cooling, or on the addition of water.

Castorin is nearly insoluble in cold, but freely soluble in boiling *acetic acid*. The solution deposits most of the castorin in needles, after some weeks only, and when allowed to evaporate spontaneously leaves it in crystals (Brandes). — It is [illegible] soluble in cold, and slowly soluble in boiling *alcohol* (B[illegible] parts of boiling 75 p. c. alcohol, forming a sol[illegible] completely in the cold; it is more freely solub[illegible]les). — It dissolves easily in *ether*, slightly [illegible] of *turpentine*, and in hot *olive oil* (Brand[illegible]

tion, filtered after cooling, and precipitated with acetic acid. The washed precipitate is dried on glass plates at the ordinary temperature (Bedall).

Properties. White or yellowish powder, appearing crystalline under the microscope. Inodorous; tastes acrid and bitter. Has an acid reaction. Free from nitrogen. Acts as a vermifuge (Bedall).

Calculation according to Bedall.			Bedall. *mean at* 125°.
52 C	312	71·56	71·19
44 H	44	10·09	10·15
10 O	80	18·35	18·66
$C^{52}H^{44}O^{10}$	436	100·00	100·00

Contains also 0·19 p. c. of ash. Bedall's formula is half the above.

Decompositions. Koussin turns brown at 150° and melts at 194°, with partial decomposition, and without volatilising. — It dissolves in *oil of vitriol*, forming a yellow solution, from which water throws down white flocks. No sugar is formed thereby, as Bedall formerly believed. — It does not reduce *alkaline solution of cupric oxide* (Bedall).

It dissolves slightly in *water*, and easily in aqueous alkalis. — The alcoholic solution is precipitated white, but incompletely, by alcoholic neutral acetate of lead. Bedall obtained lead-salts with 43·62, 66·07, and 83·11 p. c. of oxide of lead.

Koussin is soluble in all proportions of strong *alcohol* and *ether*, but only sparingly soluble in weak spirit, from which it is deposited in the form of a white resin on cooling (Bedall).

Primary Nucleus $C^{52}H^{80}$; *Oxygen-nucleus* $C^{52}H^{44}O^{14}$.

Paris Resin.

$$C^{52}H^{44}O^{16} = C^{52}H^{44}O^{14},O^{2}.$$

WALZ. *N. Jahrb. Pharm.* 13, 361.

Extracted by ether from crude paridin (p. 125), together with leaf-green, and purified by evaporating the ether, dissolving the residue in alcohol, digesting with animal charcoal, and precipitating the filtrate with water.

Soft, easily fusible mass, smelling of the plant from which it is derived.

			Walz.
52 C	312	64·46	66·23	64·36
44 H	44	9·09	8·94	9·11
16 O	128	26·45	24·83	26·53
$C^{52}H^{44}O^{10}$	484	100·00	100·00	100·00

According to Walz, it differs from paridol in containing two atoms of water less.

It colours *oil of vitriol* dark-brown. — Dissolves in fuming *nitric acid* with brown colour; slightly in *hydrochloric acid*, from which it is precipitated by water; easily in aqueous *ammonia* and *potash*, precipitable by acids. — Easily soluble in *ether*.

Paridol.

$$C^{52}H^{46}O^{18} = C^{52}H^{46}O^{18},O^{2},2HO.$$

WALZ. *N. Jahrb. Pharm.* 13, 359.

Formation. Paridin breaks up, on boiling with dilute sulphuric acid, into paridol and sugar. — There is formed at the same time amorphous paridin, which Walz formerly regarded as a third decomposition product:

$$C^{52}H^{46}O^{18} + 2HO = C^{52}H^{46}O^{18} + C^{12}H^{12}O^{12}.$$

Preparation. Paridin is boiled with 3 parts of oil of vitriol and water for a few hours, or until the finely divided paridin is converted into an oil; the paridol is dissolved in ether, and the ethereal solution left to evaporate.

Soft fusible mass, having a fatty odour.

				Walz.
52 C	312	62·16	61·04	61·02
46 H	46	9·16	9·19	9·29
18 O	144	28·68	29·77	29·09
$C^{52}H^{46}O^{18}$	502	100·00	100·00	100·00

Paridol dissolves in *oil of vitriol* with fine red colour, changing to brown. — It dissolves in fuming *nitric acid*, forming a solution, which deposits a yellow body on standing. — It is insoluble in aqueous *ammonia* or *potash*, but easily soluble in *ether*.

Glucosides of Paridol.

1. Paridin.

G. F. WALZ. *Jahrb. pr. Pharm.* 4, 3; 5, 284; 6, 10. — *N. Jahrb. Pharm.* 13, 174, and 355; *Kopp's Jahresber.* 1860, 543.

DELFFS. *N. Jahrb. Pharm.* 9, 25; *Chem. Centr.* 1858, 209; *N. Br. Arch.* 95, 330; *Kopp's Jahresber.* 1858, 527.

Occurs in *Paris quadrifolia*, and according to Walz, is also produced by boiling paristyphnin with acids, which, however, decomp[illegible] paridin.

Preparation. The coarsely powdered dried plant is t[illegible] with warm water, containing 2 per cent. of acetic [illegible] the residue is exhausted with alcohol of sp. gr. 0·[illegible] distilled till the residue solidifies to a jelly, which [illegible]

Properties. Helleborein crystallises from very strong alcoholic solutions, when left at rest, in transparent warts consisting of needles, which rapidly become chalk-white in the air. Aqueous solutions leave a yellowish transparent resin on evaporation. Very hygroscopic. Tastes sweetish. Poisonous to animals. — The aqueous solution reddens litmus very faintly.

	Dried at 120°.			Husemann & Marmé. *mean.*
52 C	312	52·35		52·27
44 H	44	7·38		7·09
30 O	240	40·27		40·64
$C^{52}H^{44}O^{30}$	596	100·00		100·00

Helleborein acquires a straw-yellow colour and cakes together when *heated* above 160°; at 230° it turns pasty and brown; and at 290° melts to a viscid liquid and carbonises. — It dissolves in *oil of vitriol* with brown-red colour, changing to violet. — It is not altered by boiling with *potash-ley*, or by *baryta-water* at 140°, but quickly breaks up on boiling with *dilute acids* into 59·85 per cent. of sugar and 40 per cent. of helleboretin, which separates in blue flocks:

$$C^{52}H^{44}O^{30} = C^{28}H^{20}O^{6} + 2C^{12}H^{12}O^{12}.$$

(calc. 60·40 p. c. of sugar and 39·60 of helleboretin).

Helleborein is very easily soluble in *water*, less freely in *alcohol*, and insoluble in *ether*.

Appendix to Helleborein.

1. *Helleboretin.* — The fine dark blue flocks deposited on boiling helleborein with acids, form, after washing and drying, a grey-green amorphous powder. Inodorous and tasteless. Not poisonous. Melts above 200° to a dark brown-red liquid and carbonises. Dissolves in oil of vitriol, forming a brownish-red solution, which is precipitated by water. — It is insoluble in water and ether, but easily soluble in alcohol, with violet colour (Husemann & Marmé).

				Husemann & Marmé. *mean.*
28 C	168	71·19		71·20
20 H	20	8·47		8·48
6 O	48	20·34		20·32
$C^{28}H^{20}O^{6}$	236	100·00		100·00

2. Helleborin.

BASTICK. *Pharm. Journ. Trans.* 12, 74; *Pharm. Viertelj.* 2, 388; *N. Repert.* 2, 61; *N. J. Pharm.* 23, 205, and 24, 159; *Kopp's Jahresber.* 1853, 482.
[illegible] & MARMÉ. *Ann. Pharm.* 135, 61.

[illegible] red by Bastick in black hellebore ro[illegible] in

black, but more abundantly in green hellebore root, especially in old thick roots, of which 25 pounds yield 4 or 5 grammes (Husemann & Marmé).

Preparation. The comminuted root is boiled repeatedly with alcohol, and the decoctions are evaporated to a small bulk. The residue containing helleborin, helleboreïn, and a large quantity of green fat is shaken repeatedly with boiling water, which takes up the first two constituents and deposits the helleborin in crystals on evaporation. It is purified by recrystallisation from boiling alcohol (Husemann & Marmé). Bastick exhausts the root with acidified alcohol, distils, supersaturates the residue with carbonate of soda, and extracts the helleborin with ether.

Properties. Shining white needles, which do not melt at 250°. Tasteless in the dry state, but very acrid and burning in alcoholic solution. Powerfully narcotic (Husemann & Marmé). Without action on vegetable colours (Bastick).

	Crystals.			Husemann & Marmé. mean.
72 C	432		75·78	75·53
42 H	42		7·37	7·33
12 O	96		16·85	16·96
$C^{72}H^{42}O^{12}$	570		100·00	100·00

Bastick supposes the body to contain nitrogen.

Helleborin melts above 250° and then carbonises.—Oil of vitriol poured upon it turns it bright-red and dissolves it; water added to the solution throws down most of the helleborin in white flocks.—It breaks up into sugar and helleboresin, with assimilation of 8 atoms of water when boiled with *dilute sulphuric acid*, or more completely when heated with solution of zinc chloride:

$C^{72}H^{42}O^{12} + 8HO = C^{60}H^{38}O^{8} + C^{12}H^{12}O^{12}$ (Husemann & Marmé).—When heated with *nitric acid* it yields oxalic acid (Bastick).

Helleborin is insoluble in cold *water*. It is not altered by *dilute acids* and *alkalis*, and does not combine with them. It is not precipitated by *iodide of potassium*, *neutral acetate of lead*, or *mercuric chloride* (Bastick).

Helleborin dissolves easily in *alcohol* and in *chloroform*; sparingly in *ether* and *fat oils* (Husemann & Marmé).

3. *Helleboresin.*—Obtained by boiling helleborin with solution of zinc chloride (which, on account of its high boiling-point, acts more powerfully than dilute sulphuric acid) as a brown resin containing zinc, which is powdered, boiled with hydrochloric acid, dissolved in boiling alcohol, and precipitated with water.—White flocks drying to a greyish white powder. Softens at 140°—150°, at the sa[illegible] turning brown. Tasteless.—Insoluble in water; slightly [illegible] ether; easily soluble in alcohol (Husemann & Marmé).

				Husemann
60 C	360		77·92	
38 H	38		8·22	
8 O	64		13·86	
$C^{60}H^{38}O^{8}$	462		100·00	

COMPOUNDS CONTAINING 54 ATOMS OF CARBON.

Primary Nucleus $C^{54}H^{48}$; *Oxygen-nucleus* $C^{54}H^{44}O^{4}$.

Chenocholic Acid.

$$C^{54}H^{44}O^{8} = C^{54}H^{44}O^{4},O^{4}.$$

HEINTZ & WISLICENUS. *Pogg.* 108, 547; *J. pr. Chem.* 78, 190; *Chem. Centr.* 1859, 873; *Rép. Chim. pure* 2, 106; *Kopp's Jahresber*, 1859, 634.

OTTO. *Ann Pharm.* 149, 198.

Chenocholalic acid.

Produced, together with taurine, by boiling taurochenocholic acid with alkalis or baryta-water. — An aqueous solution of taurochenocholic acid is boiled with a large excess of hydrate of baryta for 36 hours, or until the originally dense precipitate becomes granular. The liquid is then allowed to cool, and the insoluble baryta-salt is washed and decomposed with hydrochloric acid. The chenocholic acid thus liberated is purified by washing, pressing, dissolving it in alcohol, and evaporating. If it still contains nitrogen, derived from undecomposed taurochenocholic acid, it is again treated with baryta-water, or boiled for 6 hours with potash-ley, when the potash-salt, which is insoluble in the excess of potash-ley, is deposited on cooling. It is decomposed in the same manner as the baryta-salt.

Properties. Pale-yellow resin, obtained on one occasion in indistinct crystals from a solution in weak alcohol after long standing. After drying at 100° it is triturable to a highly electric powder. Has an acid reaction.

	Dried at 100°.			Heintz & Wislicenus. *mean.*		Otto.
54 C	324		75·00		75·31	75·1
44 H	44		10·19		10·08	10·1
8 O	64		14·81		14·61	14·8
$C^{54}H^{44}O^{8}$	432		100·00		100·00	100·0

Heintz and Wislicenus adopt the above in preference to the equally possible formula $C^{54}H^{42}O^{8}$. — Homologous with hyocholic acid.

Chenocholic acid produces with *sugar* and *oil of vitriol* the blood-red coloration of the bile-acids (p. 66).

It is insoluble in *water*. — Does not dissolve in cold strong *potash-ley*, but combines with the base, especially on warming, to form a salt which dissolves in water and is deposited from its solution in absolute alcohol as an amorphous mass on evaporation, and thrown down from the same solution by ether in the form of a tough transparent precipitate. This potash-salt precipitates flocks soluble in alcohol from many metallic salts and from neutral acetate of lead.

Chenocholate of Baryta. — The flocks obtained by double decom-

position are precipitated by ether from their solution in absolute alcohol in small white glassy needles. — Dissolves with great difficulty in water, but more easily in alcohol, forming solutions from which carbonic acid throws down carbonate of baryta.

	Dried at 100°.		Heintz & Wislicenus. *mean.*		Otto.
54 C	324	64·86	64·70		65·1
43 H	43	8·61	8·45		8·5
7 O	56	11·21	11·46		10·9
BaO	76·5	15·32	15·39		15·5
$C^{54}H^{43}BaO^{8}$	499·5	100·00	100·00		100·0

The acid dissolves in *alcohol* and *ether*.

Taurochenocholic Acid.

$$C^{28}NH^{45}S^{2}O^{12} = C^{4}NH^{5}S^{2}O^{5},C^{24}H^{40}O^{7}.$$

Th. Marsson. *N. Br. Arch.* 58, 138.
Heintz & Wislicenus. *Pogg.* 108, 547.
Otto. *Ann. Pharm.* 149, 185; *Kopp's Jahresb.* 1868, 823.

Chenocholic acid. Discovered by Marsson in goose-bile.

Preparation of the Soda-salt. Goose-bile is freed from the greater part of its mucus by the addition of a large quantity of alcohol; the filtrate is evaporated; the dry residue is treated with absolute alcohol; and the solution, filtered from mucus and colouring matter, is mixed with ether, which retains in solution fat and a peculiar crystalline substance, whilst salts of taurochenocholic acid are thrown down as a plaster-like precipitate. This precipitate contains potash, which is removed by precipitating its concentrated aqueous solution with Glauber's salt. The viscid drops thus thrown down are collected after some days, when they have become almost hard, purified by again dissolving and precipitating them as before, then dried, dissolved in [90 per cent. (Marsson)] alcohol, and mixed with ether. The precipitated soda-salt still contains a small quantity of an acid precipitable by neutral acetate of lead (Heintz & Wislicenus). A similar process is adopted by Marsson. — Otto finds that the soda-salt prepared as above contains small quantities of ammonia-salts. It may be obtained quite pure by precipitating with ammonia and basic lead acetate, decomposing the precipitated lead-salt with sulphuretted hydrogen, and neutralising with soda.

To prepare the acid, an aqueous solution of the soda-salt is precipitated with basic acetate of lead; the plaster-like precipitate is decomposed under alcohol by hydrosulphuric acid; and the filtrate is evaporated, when the acid remains in the form of a brown soft mass. It has an acid reaction, and when dissolved in water leaves a small quantity of white pearly crystals, probably of an acid corresponding to paraglycocholic acid (p. 61) (Heintz & Wislicenus). — This substance may be obtained in somewhat larger quantity by leaving an alcoholic solution of taurochenocholic acid in contact with ether and a little hydrochloric acid (Otto).

Inasmuch as taurochenocholic acid, when decomposed by baryta or alkalis, breaks up into chenocholic acid and taurine, probably taking up 2 atoms of water, its formula is assumed to be $C^{58}NH^{49}S^{2}O^{12}$. The composition of the soda-salt, however, agrees approximately with this formula, only when the salt is supposed to retain two atoms of water after drying at 110° (Heintz & Wislicenus). See below.

The soda salt gives the colour-reaction of the bile-acids with sugar and oil of vitriol. — Its aqueous solution is not precipitated by acetic, oxalic, or tartaric acid, but excess of hydrochloric acid throws down flocks of taurochenocholic acid, which dissolve in pure water.

Potash-salt. An alcoholic solution of goose-bile, mixed with ether, deposits on standing, tables of the soda-salt, and long thin white needles, probably of taurochenocholate of potash (Heintz & Wislicenus).

Soda-salt. Small rhombic tables, which deliquesce rapidly in the air. — Precipitated by ether from a solution of goose-bile in absolute alcohol, in the form of a plaster, which becomes crystalline only on addition of water (Marsson). It swells up in water like gum, and then dissolves completely.

	at 100—110°.		Marsson.	Heintz & Wislicenus. *mean.*	Otto. *mean.*
58 C	348	60·10	57·19	59·72	60·2
N	14	2·42	3·48	3·96	2·9
50 H	50	8·64	8·39	8·74	8·7
2 S	32	5·53	6·34	5·74	
13 O	104	17·96	19·82	16·29	
NaO	31	5·35	4·78	5·55	5·3
$C^{58}NH^{48}NaS^{2}O^{12}$ + 2aq.	579	100·00	100·00	100·00	

	at 140°.		Otto.
58 C	348	62·03	61·9 to 62·4
N	14	2·50	2·6
48 H	48	8·56	8·4 to 8·5
2 S	32	5·70	
11 O	88	15·69	
NaO	31	5·52	5.8
$C^{58}NH^{48}NaS^{2}O^{12}$	561	100·00	

Heintz & Wislicenus did not directly prove the presence of water in their salt. They supposed that it still contained taurochenocholate of ammonia, and consequently too much nitrogen. Marsson's salt contained also small quantities of phosphoric acid and chlorine. — Otto has shown that the salt dried at 110° gives off 2 at. water at 140°, and consequently that the formula of taurochenocholic acid is $C^{58}NH^{49}S^{2}O^{12}$ agreeing with its resolution by alkalis into chenocholic acid and taurine.

An aqueous solution of the soda-salt produces with *chloride of barium* and *chloride of calcium*, white flocks soluble in alcohol (Heintz & Wislicenus). The precipitates cohere in plaster-like masses on agitation. The baryta-salt dissolves on boiling, after addition of ammonia, and re-appears as the solution cools (Marsson). Sulphate of magnesia throws down from the soda-salt, after addition of ammonia flocks soluble in sal-ammoniac. *Neutral acetate of lead* produces no precipitate, but the basic acetate throws down a plaster-like precipitate which is insoluble in excess of the precipitant, and also on

boiling (Marson), but slightly soluble in alcohol (Heintz & Weidenbusch). The soda-salt is precipitated also by *ferric chloride*, *salts of manganese*, and *mercuric nitrate*, but not by *mercuric chloride*, *acetate of copper*, or *nitrate of silver*.

According to Otto, the solution of the soda-salt is precipitated by basic lead acetate immediately, and by the neutral acetate after some time; also by chloride of barium, chloride of calcium, sulphate of magnesia, and nitrate of silver. Taurocholeocholic acid is precipitated from the solution of the soda-salt by the stronger mineral acids, but not by acetic, oxalic, or tartaric acid.

Primary Nucleus $C^{54}H^{54}$.

Cerotene.

$C^{54}H^{54}$.

BRODIE. *Ann. Pharm.* 67, 210; *Phil. Trans.* 1848, 159.

Cirte (Gmelin).

Chinese wax is distilled, and the distillate is freed from cerotic acid by treating it with potash-ley and boiling with water. The mixture of cerotene and empyreumatic oil then remaining undissolved is purified by pressing, and crystallising, first from a mixture of rock-oil and alcohol, then from ether.—Cerotene is also formed in small quantity by distilling cerotyl-alcohol.

Cerotene resembles paraffin. It melts at 57° to 58°, and solidifies in a crystalline mass (Brodie). Melts at 57·8° and solidifies at 57° (Duffy, *Quart. J. Chem. Soc.* 5, 127).

				Brodie.
54 C	324	85·71		85·40
54 H	54	14·28		14·31
$C^{54}H^{54}$	378	100·00		99·75

Cerotene becomes fluid when *distilled* backwards and forwards in a sealed tube bent at right angles; after six distillations the tube contains inflammable gases and oils, boiling at temperatures varying from 75° to above 260°.—Moist *chlorine* converts it into chlorocerotene (Brodie).

Cerotene melting at 55° dissolves in *ether* more freely than ozocerite (Fritzsche, *J. pr. Chem.* 73, 326).

Cerotylic Alcohol.

$$C^{54}H^{56}O^2 = C^{54}H^{54},H^2O^2.$$

BRODIE. *Ann. Pharm.* 67, 201.

Cerotin.

Occurs in Chinese wax, in combination with cerotic acid.

Preparation. Chinese wax is melted with caustic potash at a gentle heat in an iron vessel; the mass is diffused through boiling water, and the milky liquid is precipitated with chloride of barium. The precipitate of cerotylic alcohol and cerotate of baryta thus thrown down is collected, washed, dried, and powdered, and then boiled with alcohol containing rock-oil, which takes up the cerotylic alcohol together with traces of the baryta-salt. The crystals obtained from this solution are purified by recrystallisation from a mixture of absolute alcohol and ether till their melting point rises to 79°, and until they are free from baryta.

Properties. Crystals melting at 79° (Brodie); melting and solidifying at 81° (Duffy).

				Brodie.
54 C	324	81·81		81·63
56 H	56	14·14		14·20
2 O	16	4·05		4·17
$C^{54}H^{56}O^2$	396	100·00		100·00

Decompositions. 1. Cerotylic alcohol volatilises when strongly *heated*, with little explosions, due to the formation of water, and yields a colourless solid distillate, melting at 70°, and separable by crystallisation from ether, into cerotene and undecomposed cerotylic alcohol. — *Chlorine* converts fused cerotylic alcohol into chlorocerotal:

$$C^{54}H^{56}O^2 + 28Cl = C^{54}Cl^{13}H^{43}O^2 + 15HCl.$$

Cerotylic alcohol is coloured by *oil of vitriol* and decomposed on warming, but in the finely divided state it forms cerotyl-sulphuric acid. — Cerotylic alcohol strongly heated with *potash-lime* is converted into cerotic acid, with elimination of hydrogen.

Cerotic Acid.

$$C^{54}H^{54}O^4 = C^{54}H^{54},O^4.$$

PROUST. *A. Gehl.* 1, 504.
JOHN. *Dessen Chemische Schriften*, 4, 38.
BUCHHOLZ & BRANDES. *Repert.* 4, 145.
BOUDET & BOISSENOT. *J. Pharm.* 13, 38; *Mag. Pharm.* 18, 52.
ETTLING. *Ann. Pharm.* 2, 265.
LEWY. *N. Ann. Chim. Phys.* 13, 438; *J. pr. Chem.* 36, 65; abstr. *Compt. rend.* 16, 675; 20, 38.
BRODIE. *Phil. Trans.* 1848, 1,147; *Phil. Mag.* 33, 217; *J. pr. Chem.* 45, 335; *Ann. Pharm.* 67, 180; abstr. *N. J. Pharm.* 15, 145.— *Phil. Trans.* 1848, 1, 159; *Ann. Pharm.* 67, 199; *Phil. Mag.* 33, 378; *J. pr. Chem.* 46, 30; abstr. *Kopp's Jahresber.* 1847 and 1848, 701.
MASKELYNE. *Quart. J. Chem. Soc.* 5, 24; abstr. *Kopp's Jahresber.* 1852, 525.

Acide sinésique (Lewy).

John distinguished the portion of bees'-wax more easily soluble in

alcohol from the less easily soluble myricin, by the name cerin. Brodie found it to be an acid, and prepared it in the pure state.

The products formed by the action of caustic potash on the cerin of the older chemists are described as cerolin, margaric acid, ceric acid, and *stearic acid*.

a. According to Boudet & Boissenot, cerin splits up on boiling with potash-ley into margaric acid and non-saponifiable cerolin, the latter of which forms (after being freed from margaric acid by extraction with alcohol) a hard, brittle substance, melting above 70°, and unalterable by alkalis. According to Etling, cerolin is insoluble in boiling potash-ley, and contains 78·92 p.c. C., and 13·42 H. According to Brodie's investigations a non-saponifiable product is obtained from cerin only when it contains myricin, and in that case this product is melissic alcohol. See compounds with 60 atoms of carbon.—*b.* According to Lewy, cerin, heated to 220° or 230° with potash-lime, evolves hydrogen, and is converted into stearic acid melting at 70° and containing 76·79 p.c. C., and 12·80 H. When boiled with potash-ley it yields another acid melting at 65° and containing 79·77 p.c. C. and 13·73 H.: Lewy's *ceric acid*. Both acids are doubtless to be regarded as mixtures containing cerotic acid, and probably palmitic and melissic acids, derived from the myricin.

Source. Cerotic acid occurs in bees'-wax, and in combination with cerotylic alcohol, in Chinese insect-wax (Brodie).

The waxy substances occurring in the vegetable kingdom, the general diffusion of which was pointed out by Pronst, were formerly regarded as mixtures of cerin and myricin; they have not, however, been sufficiently studied. A similar vegetable wax occurs as a coating on the petals of flowers (Elsner, *Schw.* 65, 145), the leaves of cabbage, poppy, and other plants; on the fruit of *Croton sebiferum*, *Tallow tebifera*, plums, figs, grapes, pomegranates, and lemons; as a coating on the stem of *Ceroxylon Andicola*; in the milk of the cow-tree, in pollen, &c. — Raw silk contains cerin, soluble in strong acetic acid (Mulder, *Pogg.* 37, 609). — Concerning the somewhat more fully investigated waxes, see Myricin; on Chinese insect-wax, p. 139 of this volume.

Formation. 1. By heating cerotylic alcohol with potash-lime (Brodie), or by similar treatment of Chinese wax (Lewy; Mackelyne), in both cases with evolution of hydrogen. — 2. By oxidising paraffin with bichromate of potash and dilute sulphuric acid, or with nitric acid; in the latter case together with succinic, anchoic, and several other acids (Gill & Meusel, *Chem. Soc. J.* 21, 466).

Preparation. 1. Bees'-wax is boiled 3 or 4 times with fresh portions of strong alcohol; and the precipitate which is deposited from the alcoholic liquids on cooling is collected, and crystallised from boiling alcohol till the melting point rises to 70°. The crystals are [illegible] in a large quantity of alcohol to a perfectly clear liquid, [illegible] tion is mixed with alcoholic neutral acetate of lead, [illegible] boiling hot from the bulky precipitate, which is [illegible] alcohol and ether till it ceases to give up anyth[illegible] The lead-salt is decomposed with very strong [illegible] cerotic acid thereby liberated is washed with [illegible] in absolute alcohol, and allowed to crystallis[illegible]

Primary Nucleus $C^{60}H^{60}$.

Melene.

$C^{60}H^{60}$.

ETTLING. *Ann. Pharm.* 2, 255.
BRODIE. *Ann. Pharm.* 71, 156.

Discovered by Ettling, who, however, mistook it for paraffin.

Formation. By the dry distillation of melissic alcohol and myricin (Brodie), or of bees'-wax (Ettling).

Preparation. Myricin is subjected to dry distillation; the distillate is freed from palmitic acid by treating it with potash-ley; and the melene which floats on the surface of the liquid is pressed between blotting-paper, rectified over potassium, again pressed, and crystallised from ether (Brodie). — Bees'-wax submitted to dry distillation yields amongst other products, a solid distillate, wax-butter. When this is pressed and melted with hot water, and afterwards boiled with potash-ley, there separates an oily body, which solidifies on cooling, and is to be boiled with water and crystallised from 90 p. c. alcohol. As thus prepared it contains an oxygenated compound, which may be decomposed by heating with oil of vitriol, after which ether will extract from the carbonaceous mass the purer melene (Ettling).

Properties. Colourless crystals, melting at 62° (Brodie), and appearing translucent and lustrous after fusion (Ettling). Volatilises below its boiling-point.

			Ettling.	Brodie.
60 C	360	85·72	84·24	85·31
60 H	60	14·28	14·92	14·44
$C^{60}H^{60}$	420	100·00	99·16	99·75

To this place probably belongs a product obtained from wax (by dry distillation ?) and examined as paraffin by Lewy. It contains on the average 84·91 p. c. C., 14·90 H. [= $C^{20}H^{21}$ (Lewy)], melts at 46·8°, and boils at 370° to 380°; its sp. gr. is 0·89, and its vapour-density 10 to 11·8 (Lewy, *N. Ann. Chim. Phys.* 5, 395).

Decompositions. 1. Melene is not attacked by cold *nitric acid* of sp. gr. 1·25, and distils unchanged with the boiling liquid. — 2. When heated with *oil of vitriol*, it slowly turns yellow, then brown. On boiling it with oil of vitriol a portion of the melene is carbonised, a second portion volatilises, and the remainder may be extracted by ether from the washed residue in its original state. — 3. Melene, when pure, is not affected by *potash-ley* or by *potassium* (Ettling).

Melissic Alcohol.

$C^{60}H^{62}O^2 = C^{60}H^{60},H^2O^2$.

BRODIE. *Ann. Pharm.* 71, 147; *Phil. Mag.* 35, 246.

Melissin. Myricyl-alcohol. — Occurs in the free state in Canaüba wax (p. 159), and may be dissolved out by alcohol (Maskelyne, *Chem. Soc. J.* [2], vii, 87).

Preparation. From Myricin. Myricin is saponified by boiling with strong potash-ley, or with alcoholic potash, or by melting with caustic potash; the alcohol that may have been employed is distilled off; and the soap, dissolved in boiling water, is decomposed by adding an acid to the boiling solution. The fused mass thereby separated is boiled repeatedly with water, and dissolved in a large quantity of alcohol; and the abundant precipitate formed on cooling is collected on a filter and purified by repeatedly dissolving in alcohol and crystallising, when the palmitic acid also formed at the time of saponification remains in solution. The product is further purified by recrystallising it from rectified coal-oil. — Or the solution of the potash-soap is precipitated by a baryta-salt; the baryta-soap is exhausted with ether; and the substances taken up thereby are crystallised repeatedly from ether or alcohol, till the melting-point rises to 70° to 80°. Pure melissic alcohol, in very small quantity, is obtained only by collecting apart that portion which crystallises from the ethereal solution when partially cooled by means of a heated funnel. — Bees-wax or Ceylon wax may be employed, instead of myricin, for the preparation of melissic alcohol (Brodie). Also Canaüba wax (Maskelyne).

Properties. Crystalline silky mass, melting at 85° (Brodie), about 88° (Maskelyne), and solidifying in a fibrous crystalline mass on cooling.

			Brodie. mean.	Maskelyne. mean.
60 C	360	82·19	82·33	82·48
62 H	62	14·15	14·11	14·24
2 O	16	3·66	3·56	3·28
$C^{60}H^{62}O^2$	438	100·00	100·00	100·00

The analyses agree more nearly with the formula $C^{62}H^{64}O^2$, which requires 82·30 p. c. C., 14·16 H., and 3·54 O.

Melissic alcohol submitted to *dry distillation*, distils partly unaltered, and is partly converted into a solid hydrocarbon, with loss of water. — It combines with *oil of vitriol* in the same way as cerotylic alcohol (p. 134). — It is converted into melissic acid by melting it with *potash-lime*. *Chlorine* acts upon it in the same way as upon cerotylic alcohol, forming a resinous body, *chlormelal*, corresponding to chloral.

	Chlormelal.		Brodie. mean.
60 C	360·0	38·50	38·67
14·5 Cl	514·8	54·90	54·83
45·5 H	45·5	4·86	4·74
2 O	16·0	1·74	1·76
$C^{60}Cl^{14.5}H^{45.5}O^2$	936·3	100·00	100·00

¶ Melissic alcohol (from Canaüba wax) repeatedly treated with *pentachloride* of *phosphorus* yields a substance melting at about 65°, but after heating with water, at 61°. Boiling alcohol extracts from this product a substance which, after two recrystallisations from ether, melts at 65°—66·5°; it appears to be a mixture of the two compounds $C^{60}H^{61}Cl$ (or $C^{62}H^{63}Cl$) and $C^{60}H^{60}Cl^2$ (or $C^{62}H^{62}Cl^2$) (Maskelyne).

The same alcohol melted in a sulphuric acid bath at 120°—135°; then mixed with a small quantity of phosphorus and excess of *iodine*, and heated for some time to 130°, is converted into *melissic iodide*. On

agitating the mass with water at 80°, then drying it and digesting with ether, the iodide remains behind as a mass melting at 67°, while a body melting at 70°—75·5° passes into solution. The iodide yielded by analysis numbers agreeing nearly with either of the formulæ $C^{60}H^{61}I$, or $C^{62}H^{63}I$.

		Calculation.				Maskelyne.	
60 C	360	65·69	62 C	372	66·19	64·56	65·72
61 H	61	11·13	63 H	63	11·21	11·16	11·12
I	127	23·18	I	127	22·60	21·74	
$C^{60}H^{61}I$	548	100·00	$C^{62}H^{63}I$	562	100·00		

The iodide is not attacked by silver oxide at 120°—130°. It appears to unite with *ammonia* and with *aniline*, forming unstable compounds, from which it is separated on boiling (Maskelyne).

Melissyl-sulphuric acid was prepared by digesting the alcohol with sulphuric acid in a water-bath till it was all dissolved or suspended, then dissolving in alcohol and saturating with alcoholic potash. A copious white precipitate was thereby produced, which, after repeated boiling with water, left a white flocculent residue, nearly insoluble in alcohol and ether, melting at 90°, and agreeing in composition with the formula $C^{62}H^{63}KS^2O^8$ more nearly than with $C^{60}H^{61}KS^2O^8$.

		Calculation.				Maskelyne.	
60 C	360	64·75	62 C	372	65·26	65·69	
61 H	61	10·97	63 H	63	11·05	11·27	
K	39·1	7·01	K	39·1	6·84	6·74	
$2SO^4$	96	17·27	$2SO^4$	96	16·85	16·30	
$C^{60}H^{61}KS^2O^8$	556·1	100·00	$C^{62}H^{63}KS^2O^8$	570·1	100·00	100·00¶	

Melissic Acid.

$$C^{60}H^{60}O^4 = C^{60}H^{60},O^4.$$

Brodie. *Ann. Pharm.* 71, 149; *Phil. Trans.* 1849, 94; *Phil. Mag.* 35, 247; *J. pr. Chem.* 48, 387.

Obtained as a crystalline mass, melting at 86° to 89°, by heating melissic alcohol with potash-lime.

			Brodie. *mean.*
60 C	360	79·64	79·66
60 H	60	13·27	13·34
4 O	32	7·09	7·00
$C^{60}H^{60}O^4$	452	100·00	100·00

Melissate of silver is obtained in the same way as the cerotate (p. 137).

			Brodie.
60 C	360	64·38	64·02
59 H	59	10·55	10·77
Ag	108	19·30	19·48
4 O	32	5·77	5·73
$C^{60}H^9AgO^4$	559	100·00	100·00

fatty acid which dissolves [palmitic acid derived from the myricin (Brodie); margaric acid according to older statements], and melene, which solidifies on cooling (Ettling's paraffin, p. 150). In this decomposition it yields neither glycerin nor volatile acids (Poleck, *Ann. Pharm.* 67, 171). — By repeated distillation, the wax-butter is converted into a very limpid yellow oil, *wax-oil*, which has a very pungent taste and smell, and, when rectified, first with water and afterwards over potash, and dried, is of sp. gr. 0·7502 at 11°, boils at 137°, and contains 84·3 p. c. C., 14·3 H., and 1·4 O. It turns syrupy and carmine-red with oil of vitriol, and when treated with dry hydrochloric acid gas, becomes dark-red, and deposits red, probably crystalline drops (Ettling).

The empyreumatic oil from wax deposits laminæ of melene in the cold. When freed from adhering margaric acid by potash, and rectified, it leaves more melene; the distillate, after treatment with potassium, boils at 160° to 220° and higher, but at all points of the distillation the product contains equal numbers of atoms of carbon and hydrogen (85·4 p. c. C., 14·6 H.) (Gerhardt).

Wax mixed with spongy platinum, and heated to 100°, is completely converted into carbonic acid and water by a sufficiently prolonged current of *oxygen*; at 280° it enters into brilliant combustion (Reiset & Millon, *N. Ann. Chim. Phys.* 8, 285). — Wax is attacked by strong *nitric acid* on gentle warming, the action being at first violent, afterwards more moderate. After digesting for some days, it floats on the surface of the acid as a thick oil, but on still longer digestion, with addition of fresh acid, it dissolves completely. The solution still continues to evolve red fumes, and if boiled till the fumes disappear, it yields, on evaporation, crystals of succinic acid, giving off at the same time a small quantity of volatile oil of rancid odour (Ronalds, *Ann. Pharm.* 43, 356). Wax boiled for two hours with nitric acid is converted into a solid mass, which is soluble in carbonate of soda, and after boiling with the acid for 24 hours, is completely dissolved, with the exception of œnanthylic acid which floats on the surface. When wax is boiled with nitric acid till it is completely dissolved, the solution yields on evaporation, pimelic, adipic, and lipic acids, but no suberic acid (Gerhardt). Deschamps (*N. J. Pharm.* 4, 205) obtained suberic, succinic, and butyric acids from white and yellow wax, and from cerin and myricin, which, according to other statements, yield also oxalic and acetic acids.

Crude wax is bleached by melting it in *chlorine-water*, or in aqueous chloride of lime, but it takes up chlorine at the same time. — It forms with *oil of vitriol*, when heated, a dark-brown transparent solution, which becomes turbid and thick on cooling, and is precipitated by water.

One hundred parts of wax, saponified with 200 parts of *caustic potash* and water, yield 34·6 parts of mixed acids, and 56·7 parts of non-saponifiable substance. The latter body begins to solidify at 75°, is quite solid at 72°, but still remains soft at 64° (Chevreul). By very strong potash-ley wax is entirely converted into a soluble soap (Lewy). When wax is boiled for 6 hours with potash-ley, it is distinctly attacked, swells up, and separates from the liquid as a creamy mass, easily soluble in water (Berzelius, Warington & Francis, *J. pr. Chem.* 32, 282). With fused caustic potash it produces the *pseudo-ceraïn* of Warington & Francis, a body allied to ceraïn (p. 135), and, like it, undoubtedly a mixed substance. See also Deschamps (*N. J. Pharm.* 4, 205), who by the action of potash on wax, obtained butyric, ulmic, and

margaric acids, an acid oil, and a non-saponifiable substance. — The wax-soap is very hard; the acid separated from it melts at 70° (Geiger & Oppermann, *May. Pharm.* 35, 62). — A little wax is saponified also by boiling for a very long time with carbonate of soda (Dupré, [illegible]). — Wax forms with warm aqueous ammonia an emulsion which deposits it on cooling, in flocks which are more easily fusible than wax, and apparently slightly soluble in water (Bostock). — It is insoluble in a boiling aqueous solution of *borax* (Batka).

Wax may be melted together with *phosphorus, sulphur* and *iodine*. — It is insoluble in cold *alcohol*, but soluble, according to Bussy & Boullay, in 20 parts, and, according to Chevreul, in 30 parts of boiling alcohol of sp. gr. 0·816. Alcohol of sp. gr. 0·816 dissolves yellow and white wax completely; weaker alcohol dissolves only white wax (Van der Vliet, *J. pr. Chem.* 16, 302). — Wax is insoluble in cold, but soluble in 10 parts of boiling *ether* (Bostock). — It dissolves partially in cold *chloroform* (A. Vogel), in which yellow wax turns white (Batka). It is soluble in hot *acetone*, partially separating on cooling (Chevreul), and in all proportions of warm *volatile oils*, which deposit the greater part on cooling. Melted wax mixes with *fat oils*, forming uniform masses, *cerates*. — On the adulteration of wax and its detection, see Chateau (*Mulhous. Soc. Bull.* 32, 406); on the detection of paraffin in wax, see Liès-Bodart (*N. J. Pharm.* (4) 3, 217).

2. Other varieties of Wax.

Wax of Leaves and Fruits. — The wax of *cabbage-leaves* is fusible, and after melting solidifies at 75° to 73° to a soft mass, hardening at 65°. It is not saponifiable by caustic potash (Chevreul). — Einhof (*A. Gehl.* 6, 63) obtained from *green barley-stalks* a green saponifiable wax, and from the dry straw a yellow wax.

When leaves (of *Pyrus communis*) which have become yellow are freed from leaf-yellow (xvi, 515) by exhausting them with cold alcohol, and afterwards boiled with alcohol, the decoction solidifies to a jelly on cooling. This jelly, when washed with cold alcohol and dissolved in boiling alcohol, is obtained in milk-white, chalky lumps, which melt at 75° and are solid and opaque after cooling. The wax is inodorous and tasteless; it distils unchanged out of contact with air, and is insoluble in caustic potash. It dissolves in 425 parts of alcohol, and is deposited from a hot solution, on cooling, in the form of a translucent paste. It is rather more freely soluble in cold ether (Berzelius, *Ann. Pharm.* 21, 258).

When *grass* is exhausted with ether, the solution evaporated and the residue dissolved in boiling alcohol, the solution deposits on cooling a white wax, containing after fusion, 79·3 p. c. C., 13·3 H., and 7·4 H. — The leaves of syringa similarly treated yield a wax containing 79·9 p. c. C., and 13·3 H., and resembling the wax of vine-leaves (Mulder, *J. pr. Chem.* 32, 174).

The *white rime with which fruit is covered* is a resin which exists as a varnish while the fruit is unripe, and appears as a white powder on the ripe fruit. It is dissolved by washing the whole fr[illegible] ether, and remains, on evaporating the solution, as a white [illegible] powder; or if the ether contains alcohol, the residue sol[illegible] jelly. — The resin is amorphous, inodorous, and tasteless,

ping (*Ann. Pharm.* 45, 287). See also Bley (*N. Br. Arch.* 17, 179). It is uncertain whether Boussingualt's cork-resin (xvi, 204) belongs to this place or not.

Ceric acid. Produced by the action of nitric acid on cork-wax, or by treating cerin with a little nitric acid of sp. gr. 1·35, whereupon the ceric acid rises to the surface as an oil, a part remaining in solution and being precipitated on addition of water. The product is washed with hot water, dissolved in alcohol, and evaporated. It forms a yellowish-brown, translucent, waxy mass, melting below 100° and containing 64·23 p. c. C., 8·77 H., and 27·00 O. It dissolves easily in ammonia and potash, from which it is precipitated by acids. It forms a neutral lead-salt containing 22·40 p. c. PbO., obtained by precipitating the alcoholic acid with neutral acetate of lead, and a basic salt containing 46·18 p. c. PbO., obtained by precipitating the ammoniacal acid with neutral acetate of lead (Döpping, *Ann. Pharm.* 45, 292).

Wax from the milk of the Cow-tree (*Galactodendron utile*). — When the residue left on evaporating the milk is exhausted with cold absolute alcohol and with alcohol of sp. gr. 0·89, these liquids take up resins; and from the undissolved portion, boiling absolute alcohol dissolves the wax, which it deposits on cooling. — Neutral small grains, made up of microscopic pointed needles Melts at 65° and is saponified with difficulty by potash. Dissolves sparingly in cold, more freely in boiling ether, which becomes turbid or gelatinous on cooling. Contains 78·82 p. c. C., 12·39 H., and 8·79 O., corresponding to the formula $C^{70}H^{66}O^{6}$. The same wax occurs in a vegetable milk from Marmato, in Columbia (Heintz, *Pogg.* 65, 240). See also Boussingault & Ricero (*Ann. Chim. Phys.* 23, 219), Solly (*Phil. Mag.* 11, 452). The wax of the cow tree is identical with bees'-wax (Boussingault, *Ann. Chim. Phys.* 59, 24).

The ripe *capsules of the blue-seeded poppy* contain a wax sparingly soluble in ether, allied to cerain, and an easily soluble wax allied to myricin (Winckler, *Repert.* 59, 27).

Cuba wax. — Dirty yellowish-brown, or liver-coloured wax, honey-yellow in thin sheets, rather softer than ordinary bees'-wax. It is insoluble in water, but completely soluble in boiling alcohol, hot oil of turpentine, and boiling ether. In cold ether it falls to a granular powder. Contains 9 p. c. of soft resin, 77 p. c. of cerin, and 10·5 p. c. of myricin (Brandes, *Ann. Pharm.* 10, 239).

Wax of Elecampane root. — Obtained by exhausting the root, first with water, then with boiling alcohol, which deposits the wax on cooling. — Yellowish-white, tough between the teeth, and somewhat sticky. Tasteless. Deposited from its solution in hot alcohol and ether in the form of a yellowish-white powder (John, *Chem. Schrift.* 4, 65). Probably impure helenin (xvii, 522).

Wax of Hops. — Extracted from fresh hops by ether, together with hop-bitter and other substances, and purified by treating the ethereal extract with cold alcohol, which leaves it undissolved, and crystallising from hot alcohol (Lermer, *Pharm. Viertelj.* 12, 506).

Wax of Juniper berries. — When the berries are boiled with alcohol and the decoction is filtered hot, it deposits on cooling a grey, brittle,

friable wax, which melts to an oil in boiling water, emitting an odour of wax. When submitted to dry distillation, or when burnt, it behaves like other waxes. It is converted into a resin by long boiling with nitric acid, and does not dissolve in aqueous potash, even after prolonged boiling. It is freely soluble in hot alcohol, which deposits the whole of it on cooling; insoluble in cold, but soluble in hot ether; and easily soluble in warm fatty and volatile oils (Brandenstein, *Taschenb.* 1822, 48). Nicolet's juniper wax (*J. Pharm.* [illegible]), extracted by alcohol from juniper berries, previously boiled with water and dried, behaves in a similar manner.—When juniper berries are distilled with water to obtain the volatile oil, the residue in the still, strained while hot, deposits on cooling and concentrating, a mixture of wax and resin, from which cold alcohol takes up the resin. The undissolved wax, purified by repeated crystallisation from alcohol, with the help of animal charcoal, is white and fusible, and breaks up, after fusion, into hard angular pieces, which are translucent and lustrous. It dissolves in boiling potash-ley, and is deposited on cooling (Stenz, *Wien. Acad. Ber.* 21, 383).

The pollen of *Lilium croceum* gives up to ether a yellow wax, which bleaches on exposure to light, and is saponified with difficulty by potash. It contains 79·59 p. c. C., 12·04 H., and 8·37 O. (Frémy & Chevr, *N. J. Pharm.* 25, 161; *Pharm. Centr.* 1854, 458).

Wax of the fruit of the Mountain Ash and of the root of the Apple-tree. — *a.* Extracted from the fruit by ether and bleached by chlorine. — *b.* Obtained in the preparation of phloridzin. According to Mulder, both waxes have the same composition, and occur generally throughout the vegetable kingdom; *a* contains 68·49 p. c. C., and 9·27 H.; *b*, 68·69 p. c. C., and 8·88 H. (Mulder, *J. pr. Chem.* 32, 172).

Palm-wax. — *Ceroxylin* or *Cerosilin.* — The trunk of *Ceroxylon Andicola*, a palm of New Granada, is covered with a substance which may be scraped off, and when purified by boiling with water and made into balls, forms the *cera de palma.* It is a mixture of wax and resin (xvii, 405), from which the wax may be separated by dissolving it in a large quantity of boiling alcohol: the solution deposits the wax, on cooling, in the form of a white jelly, which is freed from adhering resin by crystallising it repeatedly from boiling alcohol.—Very delicate silky needles (Bonastre). Yellowish-white, resembling bees'-wax, melting in boiling water (Boussingault), at 72° (Lewy), to a faintly coloured liquid. Contains, on the average, 80·3 p. c. C., 12·7 H. (Boussingault), 80·7 p. c. C., 13·3 H. (Lewy). Dissolves in boiling alcohol, and more freely in ether. Boussingault (*Ann. Chim. Phys.* 29, 333; 59, 19). Lewy (*N. Ann. Chim. Phys.* 13, 447). Bonastre (*J. Pharm.* 14, 349). The wax known as *Cire des Andaquies* contains, besides cerosin (p. 61), a substance resembling palm-wax, which dissolves less easily than cerosin in boiling alcohol, melts at 72°, and contains 80·95 p. c. C., 13·37 H., and 5·68 O. (Lewy). — The wax dissolved off the leaves of *Chamærops humilis* is resolved by boiling alcohol into cerin and myricin. The leaves also give up cerin to boiling alcohol (Teschemacher, *Phil. Mag.* 28, 350; *J. pr. Chem.* 39, 220).

Wax (?) from the bark of Platanus acerifolia.—Obtained by boiling ethereal extract of the bark with dilute potash-ley to remove [illegible]

MAGNUS. *Ann. Chim. Phys.* 55, 217.
MALAGUTI. *Ann. Chim. Phys.* 63, 390; *J. pr. Chem.* 11, 136; *Ann. Pharm.* 23, 286.
PH. WALTER. *Ann. Chim. Phys.* 75, 214; *J. pr. Chem.* 22, 181.

Bergwachs.—Amorphous compact masses, containing hydrocarbons differing in melting point, but of the same composition, and yielding by dry distillation chiefly paraffin or a very similar substance.

Ozocerite from Slanik in Moldavia is leek-green or yellowish-brown, translucent to semi-transparent, flexible, and of the consistence of tallow or wax. Sp. gr. 0·955 to 0·97. Burns with a bright flame (Glocker). Melting-point 82° (Magnus). Boils at about 210°, and yields a distillate consisting of first a little oil, then a solid mass, giving off gaseous products, and leaving 5·7 p. c. of charcoal. It is only slightly soluble in boiling absolute alcohol, but dissolves completely in bisulphide of carbon, ether, rock-oil, and oil of turpentine, forming solutions which are leek-green by reflected, and reddish-brown by transmitted light (Schrötter). Boiling ether and absolute alcohol take up little, but hot oil of turpentine dissolves it entirely (Magnus). On drenching it with ether, a portion dissolves, the rest splitting into fine spangles. Under benzol, ozocerite becomes covered with a jelly, and does not dissolve completely until it is warmed (Fritzsche).

Ozocerite from Zietrisika in Moldavia melts at 84° and boils at 300°. Sp. gr. 0·946 at 20·5°. It is not attacked by alkalis, but softens in a stream of chlorine, and becomes soluble in boiling ether. It is not affected by cold oil of vitriol, but is carbonised by hot oil of vitriol, forming with the latter a solution from which water throws down black flocks, which give up to boiling ether white crystals melting at 72° (Malaguti).

The ozocerite of Trascowiec, in Gallicia, was found by Walter to melt at 59°, and by Schmid at 65°. It is not affected by oil of vitriol; yields paraffin on distillation (Walter).

Ozocerite from Boryslaw, in Gallicia, is of a dark black-brown colour, and may be kneaded between the fingers. Its melting point is 60°; its sp. gr. 0·944. Its solution in boiling alcohol deposits, on cooling, crystals of the three forms in which paraffin crystallises. By fractional crystallisation it yields products melting at 60° to 65°, of the same composition as paraffin, and behaving in the same way with nitric acid: that melting at 61° contains 84·94 p. c. C., 14·87 H.; that melting at 65·5 85·78 p.c. C., 14·29 H. (Hofstätter).

The ozocerite from the Urpeth coal-mine near Newcastle is soft, unctuous, and sticky. It melts at 60° and becomes perfectly limpid at 70°. Contains 85·18 p.c. C. and 14·06 H., but is a mixture of at least three substances of the same composition and equally indifferent towards boiling acids. Cold ether takes up $\frac{4}{5}$ths of the ozocerite, forming a greenish-brown solution, which when allowed to evaporate, spontaneously, deposits it in brown flocks melting at 39° and of sp. gr. 0·885. From the remaining $\frac{1}{5}$th, boiling ether or alcohol takes up a colourless or pale-yellow mass of the hardness of wax and melting at 58°. The undissolved portion, amounting to $\frac{1}{6}$th of the whole, is dark-brown, soft, of sp. gr. 0·965, melts at 73°, boils at 260°, and is nearly insoluble in boiling alcohol and ether (Johnston, *Phil. Mag.* 12, 12, 389; *J. pr. Chem.* 14, 226).

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible]

Decompositions. Aconitine begins to turn brown at 120°, and when more strongly *heated* decomposes and gives off ammoniacal vapours without volatilising. — 2. When heated on platinum foil, it takes fire, and leaves a shining light charcoal, which burns without residue. — 3. *Oil of vitriol* colours it yellowish, then dirty-red (Geiger & Hesse), violet-red (Hottot). Its solution in sulphuric acid is coloured a dirty-green by bichromate of potash, but is not affected by peroxide of lead (Riegel).

Combinations. — With Water. Aconitine precipitated by ammonia in the cold, and dried at a moderate temperature, is a hydrate which melts and gives off 20 to 25 per cent. of water at 85° (Hottot & Liégrois). See the contrary above. — Aconitine is nearly insoluble in *water* (v. Planta). It dissolves in 150 parts of cold, and in 50 parts of boiling water, forming a solution which does not become turbid on cooling (Geiger & Hesse).

With Acids. — Aconitine neutralises acids completely, forming uncrystallisable salts (Geiger & Hesse; v. Planta). An aqueous solution of the hydrochlorate gives with ammonia, potash, and carbonate of potash, white precipitates slightly soluble in excess of the precipitants. Carbonate of ammonia, bicarbonate of soda, and phosphate of soda produce no precipitate (v. Planta). Tartaric acid prevents the precipitation of aconitine by bicarbonate of soda (Riegel). Aconitine precipitated by ammonia from cold solutions is hydrated; that precipitated from boiling solutions is anhydrous (Hottot & Liégrois).

Hydrochlorate of aconitine is precipitated kermes-brown by *tincture of iodine* (Geiger & Hesse); also by *biniodide of potassium* (Wagner).

Hydrochlorate of Aconitine. — One hundred parts of aconitine exposed to a current of dry hydrochloric acid gas and afterwards to a current of air at 100°, take up 15·49 parts, or 2 atoms, of the acid (v. Planta).

			v. Planta.
$C^{60}NH^{47}O^{14}$	533	87·95	86·59
$2HCl$	73	12·05	13·41
$C^{60}NH^{47}O^{14},2HCl$	606	100·00	100·00

Phosphantimonic acid (xiv, 227) produces an abundant white precipitate in solutions of hydrochlorate of aconitine containing $\frac{1}{1000}$th of the salt (Schulze). *Phosphomolybdic acid* precipitates it pale-yellow and flocculent (Sonennschein). The precipitate dissolves in ammonia-water with blue colour, which disappears on boiling (Trapp, *Russ. Pharm. Zeitschr.* 2, 1; *Kopp's Jahresber.* 1863, 702). — Hydrochlorate of aconitine gives with *iodomercurate of potassium* an amorphous white precipitate (Delffs), and with *mercuric chloride* a white curdy precipitate, soluble in hydrochloric acid and in sal-ammoniac (v. Planta).

Chloroaurate of Aconitine. — Dense, amorphous, yellowish-white precipitate, not perceptibly soluble in hydrochloric acid (v. Planta).

			v. Planta
60 C	360	[illegible]	[illegible]
N	14	[illegible]	
50 H	50	[illegible]	[illegible]
Au	196·5	[illegible]	[illegible]
4 Cl	141·5	[illegible]	
16 O	128	[illegible]	
$C^{60}NH^{47}O^{14},HCl,AuCl^3 + 2aq$	[illegible]	[illegible]	

The presence of water in the salt is not established.

Bichloride of platinum does not precipitate [illegible] tine (Geiger & Hesse; v. Planta). [illegible] down a white precipitate; *picric acid* [illegible] ammonia. *Tincture of galls* and [illegible] a drop of hydrochloric acid, dense [illegible] hydrochloric acid (v. Planta).

Aconitine dissolves very easily in [illegible] & Hesse). It is soluble in 4[illegible] parts [illegible] easily soluble in *benzole* (Hot[illegible] & [illegible]).

According to Hübschmann [illegible] dissolves in 2 pts. ether, in 2[illegible] solvents leaving it on evaporation [illegible] vitreous lustre. Cold benzol [illegible] dissolves it. On heating it [illegible] on cooling. — English aconitine [illegible] pts. of boiling ether, which [illegible] solved. The solution deposits [illegible] solves in 230 pts. chloroform [illegible] solutions it likewise crystallizes. [illegible] leaves it in the state of powder; [illegible] dissolves, and separates on cooling [illegible] form of powder.

Appendix to Aconitine.

1. *Napelline.* — Obtained from [illegible] stance is treated with the smallest [illegible] dissolve out the aconitine; the [illegible] the filtered solution [illegible] excess of lead is thrown [illegible] is evaporated to dryness [illegible] residue is exhausted with [illegible] decolorized with [illegible] becomes of the consistence of [illegible] a bitter, afterwards [illegible] evolves nitrogen [illegible] Dissolves in water [illegible] precipitated from [illegible] more easily than [illegible] (Hübschmann, [illegible] *Pharm. Viertelj.* 7. 134; N. [illegible]

sulphur-yellow precipitate [greenish-yellow (Larocque & Thibierge)], not perceptibly soluble in hydrochloric acid (v. Planta). — The salt is obtained by mixing hydrochlorate of veratrine with excess of gold-solution, washing the precipitate with water, drying, and dissolving it in hot alcohol, which deposits yellow silky crystals on cooling. It is purified by recrystallisation from alcohol (G. Merck).

	Dried at 110°.		G. Merck. mean.
64 C	384	41·25	41·18
2 N	28	3·01	
53 H	53	5·69	5·94
16 O	128	13·75	
Au	196·4	21·09	21·01
4 Cl	141·6	15·21	
$C^{64}N^{2}N^{52}O^{16}$,HCl,$AuCl^{3}$	931·0	100·00	

Hydroferrocyanate of veratrine behaves like the codeine-salt (xvii, 35) (Dollfus). — Sulphocyanide of potassium does not precipitate acetate of veratrine (Artus, *J. pr. Chem.* 8, 255), or throws down gelatinous flocks from strong solutions only (Fresenius). According to O. Henry (*J. Pharm.* 24, 194) it occasions a precipitate of light flocks in acetate of veratrine, whilst, according to Lepage, it immediately produces a pulverulent precipitate in a solution of veratrine in water acidulated with sulphuric acid.

Veratrine dissolves easily in *vegetable acids.* — *Rhodizonate of veratrine* is hyacinth-red, and easily soluble in water and alcohol. The *croconate* forms a yellow amorphous bitter mass (Heller, *J. pr. Chem.* 12, 229).

Alcoholic veratrine is not precipitated by alcoholic *picric acid* (Kemp). Picric acid throws down a sulphur-yellow precipitate from hydrochlorate of veratrine (v. Planta).

Veratrine is insoluble in aqueous *alkalis* and only very slightly soluble in *caustic ammonia* (Merck).

It dissolves very easily in cold weak *alcohol*, which leaves it on evaporation in the form of a varnish turning white and pulverulent in contact with water (Merck). According to Cap & Garot it dissolves in 1·5 part of alcohol; according to Delondre, in 11 parts of alcohol of 36°. Commercial veratrine dissolves in almost all proportions of absolute alcohol (Fröhner, *Pharm. Zeitschr.* 1854, 11).

Veratrine dissolves rather less freely in *ether* than in alcohol (Pelletier & Caventou). Dissolves in 6 parts of ether (Delondre); commercial veratrine in 10 parts of ether (Fröhner). Insoluble in ether (Meissner; O. Henry), even when boiling (Merck). — Veratrine dissolves in 1·6 part (M. Pettenkofer), in 8·62 parts of *chloroform* (Schlimpert); in 96 parts of *glycerin* (Cap & Garot); in cold *creosote* (Reichenbach); in 56 parts of *olive oil* (Pettenkofer); in 100 parts of *fat oil* (Cap & Garot, *N. J. Pharm.* 26, 81).

Appendix to Veratrine.

1. Sabadilline.

COUERBE. *Ann. Chim. Phys.* 52, 376; *J. Pharm.* 19, 534; *Ann. Pharm.* 9, 114.

According to Couerbe, this body occurs, together with veratrine, in sabadilla seeds, and is obtained in the preparation of veratrine according to page 179. The water in which the crude veratrine is boiled deposits on cooling, first crystals of sabadilline, and afterwards on evaporation reddish acrid oily drops of gum-resin (Couerbe). When the sulphuric acid extracts of sabadilla seeds prepared by Delondre's process are precipitated by potash-ley, and the liquid, filtered from the veratrine thereby thrown down, is evaporated, there remains a residue from which ether takes up a little veratrine, the rest leaving with cold water a solution which deposits crystals of sabadilline together with gum-resin (Delondre).

Simon (*Poggendorff*. 43, 403) regards sabadilline as a compound of resinate of veratrine with resinate of soda, from which veratrine may be obtained by dissolving it in water acidulated with sulphuric acid, and precipitating with excess of ammonia. According to Hübschmann (*Pharm. Viertelj.* 1, 598), however, sabadilline is a peculiar body.

Sabadilline forms white tufts of small needles, apparently decided, of very acrid taste (Couerbe). It does not provoke sneezing (Hübschmann). Has a strongly alkaline reaction. Melts to a brown resinous mass at 200°, and does not sublime at higher temperatures.— The *hydrated crystals* lose 9·535 p. c. of water at 180° in a vacuum (4 at. = 8·89 p. c. HO) (Couerbe).

Dried at 180° in a vacuum.					Couerbe. mean.
40 C	240		64·27		63·35
2 N	28		7·50		7·35
26 H	26		6·95		6·98
10 O	80		21·40		22·32
$C^{40}N^{2}H^{26}O^{10}$	374		100·00		100·00

Sabadilline turns black at a high temperature, gives off faint clouds, and leaves a large quantity of charcoal.— *Chlorine* deprives it of hydrogen, and forms a brown friable mass.— *Oil of vitriol* turns it brown, and carbonises it. Hot *nitric acid* converts it into an acid resin, without producing oxalic acid.

Sabadilline dissolves in warm water and crystallises from the solution.— It forms with *sulphuric acid* a salt containing 15·9 p. c. of the acid (Couerbe), the solution of which is not precipitated by ammonia (Hübschmann).

Alcohol dissolves several times its weight of sabadilline, but yields no crystals. The solution of anhydrous sabadilline in absolute alcohol is not alkaline, whereas that of the hydrated substance is strongly alkaline.— Sabadilline is quite insoluble in *ether*.

2. Couerbe's *monohydrate* or *resinigomme de sabadilline* is also obtained in the preparation of veratrine, according to page 179. [illegible] red resin, melting at 165°, having a very acrid taste and [illegible] alkaline reaction. It is easily soluble in water, and [illegible] to form amorphous salts, from which it is precip[illegible] It dissolves abundantly in alcohol, but only very [illegible] Contains 2 atoms of water more than sabadilline

8. CICUTINE. — From *Cicuta virosa*. When the fresh roots turated with water and expressed, and afterwards exhauste acidulated water, and the extracts are evaporated and distille potash, a distillate is obtained which has the odour of cicuta, which there floats a yellow pellicle (Polex, *N. Br. Arch.* 18, The seeds yield by distillation with potash, an alkaline distillate a disgusting odour. The expressed juice of the plant, free albumin by boiling, yields aqueous cicutine with a little a (Wittstein, *Repert.* 68, 19). — According to Buignet (*N. J. Pha* 252) cicutine rotates polarised light to the right; $[\alpha]$ r = 15·9°.

¶ 9. CODAMINE $C^{38}NH^{23}O^{6}$ (Hesse, *Ann. Pharm.* 153, 56; *Centr.* 1870, 167). A base contained in small quantity, togethe several others, in the aqueous extract of opium.

Preparation. The aqueous extract is precipitated with ex lime or carbonate of soda; the liquid separated from the precip agitated with ether, and the ethereal extract is mixed with acet After removing the ether, the acid solution is poured in a thin into moderately dilute potash- or soda-ley, the alkali being excess, and the liquid stirred to prevent the caking togeth resinous precipitate (P) containing papaverine and thebaine. Thi cipitate is separated after 24 hours, and the filtrate, after super tion with hydrochloric acid, is immediately mixed with am whereby a flocculent precipitate is produced, then with chlo without previous filtration, and the chloroform solution is treate acetic acid. After removal of the chloroform, the acid sol exactly neutralised with ammonia, whereby a reddish, resinous, crystallising precipitate is formed, containing *lanthopine*. A hours the yellowish solution is decanted, filtered, and added smallest quantity of potash-ley sufficient to precipitate it (this q must, however, be large enough to decompose all the ace ammonia in the liquid, and leave an excess sufficient to precipit bases). The potash-solution thus obtained is turbid from se *codeine*, which may be completely removed by agitating the liqu ether, as it is much more soluble in ether than the other bas latter indeed are not taken up by the ether till they have been by sal-ammoniac. The ethereal solution left to evaporate very in a tall narrow cylinder, yields in the first place a crystalliss *laudanine;* and on diluting the mother-liquor with a little washing with aqueous bicarbonate of soda, and leaving the e evaporate, crystals of *codamine* are very soon deposited.

Codamine recrystallised from ether forms large colourless si prisms mostly terminated by domes. Melts at 121° and solid the amorphous state on cooling; decomposes at a higher temp Tasteless.

	Dried at 100°.		Hesse.
38 C	228	72·84	72·77
N	14	4·47	4·35
23 H	23	7·34	7·29
6 O	48	15·35	15·59
$C^{38}NH^{23}O^{6}$	313	100·00	100·00

Codamine is easily soluble in boiling water, forming an

. It neutralizes acids, forming amorphous bitter salts. It
e in strong nitric acid with dark green, and in strong sulphuric
h blue colour becoming green and finally dark violet, when
tion is heated. Ammonia and potash produce a colourless
flocculent precipitate soluble in excess.
rophosphate of cinchonine is a yellow, amorphous precipitate
ly soluble in water and hydrochloric acid, and yielding in
s 1867 p. c. platinum, the formula [illegible] requiring
.c.
hoine dissolves easily in alcohol and ether, still more in chloro-
d benzol; all these solutions have a dichroic reaction. ¶ —

. Cinchonine. — An alkaloid of opium, contained in the liquids
which morphine has been precipitated in the preparation of that
The liquid is freed from alcohol and mixed with milk of lime,
e pasty precipitate thereby produced is exhausted with alcohol,
on cooling deposits the cinchonine in the form of a white crystal-
ass. This is dissolved in dilute hydrochloric acid, and the chlo-
et aside to crystallize, whereupon hydrochlorate of cinchonine
separates, and after some weeks hydrochlorate of cinchoninine
lises out, and is purified by 6 or 7 times repeated crystallization.
all, strongly alkaline crystals, which are soluble in all of usual
blue, changing to green on addition of nitrate of potash. The
re crystalloidalle, and have a bitter, peppermint-like taste; their
es readily gelatinize. — The alkaloid dissolves in 1200 parts of
od more easily in hot water; it is insoluble in aqueous alkalis
ether (T. & H. Smith, *Pharm. Journ.* 6, 240; 8, 56; *Schmidt*,
. Wochenschr. 1867, 136).

. Cinchrine. — *Acline Cinchrine* contains a vegetable base,
crystallises in rhombic prisms, dissolves in water and alcohol,
in ether, and forms with sulphuric acid a salt crystallizing in
(Fickinn, *Kosts. Arch.* 11). — On distilling the seeds with lime
ater, an alkaline distillate is obtained, which, when evaporated
cess with sulphuric acid, yields sulphate of ammonia and a salt
in ether-alcohol. From the latter salt the base is set free by
potash. It smells like conine or nicotine, decomposes metallic
and precipitates tincture of iodine (*Wolle, N. Jahrb. Pharm.* 12,

. Cytisine. — From the ripe seeds of *Cytisus Laburnum*,
lier & Lassaigne (*J. Pharm.* 4, 240, and 455; 7, 250) obtained
this source an amorphous bitter substance, which, according to
er & Jacquelin (*J. Chim. méd.* 6, 6) occurs also in the leaves of
lla varia. See also Scott Gray (*N. J. Pharm.* 22, 189). —
seeds of *Cytisus Laburnum* contain laburnine (p. 236).
e aqueous extract, purified by precipitation with lead
nd highly concentrated, is precipitated with tannic acid
e is decomposed by drying it with oxide of lead; and
racted from the dry residue by alcohol. For
ted into nitrate, the aqueous solution of which is
s with excess of lead oxide; and the dry residue
boiling absolute alcohol, which leaves the cyt
XVIII.

poration. — Colourless crystalline mass, subliming undecomposed between watch-glasses. Has a strongly alkaline reaction. — It deliquesces in the air, neutralises acids, and yields with nitric acid a salt which forms well-defined crystals. The hydrochlorate also forms crystallisable double salts with bichloride of platinum and terchloride of gold (A. Husemann & Marmé, *Krit. Zeitschr.* 8, 161; *Chem. Centr.* 1865, 781).

13. Diosmine. — From the leaves of *Diosma crenata.* Deposited from the alcoholic tincture, on standing, in stellar groups of crystals, which taste very bitter and like mint, and emit the odour of the leaves when chewed. Combustible. Insoluble in water; soluble in dilute acids, from which it is not precipitated by alkalis; slightly soluble in weak spirit, freely in ether and volatile oils (Landerer, *Repert.* 84, 62).

14. Ergotine. — The active constituent of ergot of rye. — a. *Ergotine of Wiggers.* — Extracted by alcohol, together with mycose (xv, 301), and vegetable osmazome, from ergot of rye previously freed from fat by ether. — Red-brown powder, resembling cinchona-red, and having a peculiar odour becoming more distinct on warming, and a bitter aromatic taste. According to Ludwig, it probably contains nitrogen, and may be regarded as a modified albumin.

When heated it emits a peculiar smell, carbonises, and burns without melting. It dissolves in oil of vitriol, forming a reddish-brown solution, from which it is precipitated in grey flocks by water. The alcoholic solution is bleached by chlorine, with separation of white flocks. — It is insoluble in water, and in aqueous solutions of alkaline carbonates, but dissolves easily in potash-ley, and is precipitated from the solution by dilute sulphuric acid. It dissolves in alcohol with red-brown colour, and in strong acetic acid, from both of which liquids it is thrown down by water (Wiggers, *Ann. Pharm.* 1, 129). — See also Neidhardt (*N. J. Pharm.* 18, 1), who regards ergotine as resin together with colouring matter; Ingenohl (*N. Br. Arch.* 62, 17).

According to Bonjean (*N. J. Pharm.* 1, 174: *Berz. Jahresber.* 27, 481) Wiggers's ergotine is medicinally inactive. Active ergotine is contained in the aqueous extract of ergot, together with albumin which may be removed by boiling, and other substances the separation of which Bonjean does not describe. It forms a reddish-brown extract, having a pungent bitter taste, styptic but not poisonous, soluble in water, insoluble in alcohol and ether.

b. *Ecboline, Ergotine, and Ergotic acid of Wenzell.* — An aqueous infusion of ergot of rye, prepared with cold water, is precipitated with neutral acetate of lead; the filtrate is freed from excess of lead by hydrosulphuric acid; the liquid is concentrated; and powdered mercuric chloride is added thereto, so long as a precipitate is produced. From this precipitate, after washing, decomposing with hydrosulphuric acid, and filtering off the mercuric sulphide, hydrochlorate of ecboline is obtained. — The liquid filtered from the mercuric chloride precipitate gives with phosphomolybdic acid a precipitate containing ergotine, which body is obtained by warming the precipitate with carbonate of baryta, filtering and evaporating the filtrate.

Both alkaloïds are amorphous, brown, and slightly bitter. They have an alkaline reaction, and burn when heated, emitting an odour

f flesh. Ecboline is poisonous; it dissolves in nitric acid without lteration; oil of vitriol colours its solution dark rose-red. — Both form morphous salts, and are precipitated by phosphomolybdic acid, tannic cid, and terchloride of gold. Bichloride of platinum precipitates cboline dark-yellow, and ergotine (after addition of ether-alcohol) ellowish. Cyanide of potassium gives a white precipitate with ecboline, but none with ergotine. — Both substances are soluble in water and alcohol; insoluble in ether and chloroform.

Ergotic acid passes over, together with formic acid, on distilling the aqueous infusion of ergot with dilute sulphuric acid (Wenzell, *Pharm. Ztm. J.*, 36, 193; *Pharm. Viertelj.* 14, 18).

On other constituents of ergot of rye, see Ludwig (*N. Br. Arch.*) 114, 193, where may be found also references to the voluminous literature of the subject, and an epitome of older researches.

15. Eupatorine. — From the leaves and flowers of *Eupatorium cannabinum*, from which it is obtained by boiling with water containing sulphuric acid, saturating the filtrate with lime, exposing the precipitate to the air till the lime is converted into carbonate, exhausting with alcohol of 40° B., and distilling off the alcohol; the eupatorine is then left as a white powder. — It tastes bitter and pungent. When heated it puffs up and burns. It is insoluble in water, but soluble in absolute alcohol and ether. With sulphuric acid it forms a salt which crystallises in silky needles (Righini, *J. Pharm.* 14, 623; *Mag. Pharm.* 25, 98).

16. Fagine. — From beech-nuts. The fagine of Buchner and Herberger (*Br. Arch.* 35, 149; *Repert.* 57, 381) is a yellowish-brown tenacious mass, of repulsive odour, susceptible of distillation with water and alcohol, but not alone. — The body obtained by Zanon (*Repert.* 57, 386), by precipitating an emulsion of the press-cake with hydrate of lime, and exhausting the precipitate with alcohol, is a sticky fatty mass, having an alkaline reaction [possibly oleate of lime? (Kr.)]. The volatile base obtainable from beech-nuts is, according to Brandt & Rakowiecki (*Pharm. Viertelj.* 13, 333) trimethylamine.

17. Fumarine. — In *Fumaria officinalis*. This plant contains an alkaloid resembling corydaline, soluble in water and alcohol, insoluble in ether, precipitated by basic acetate of lead (Peschier, *N. Tr.* 17, 2, 80). — Hannon treats the bruised herb with dilute acetic acid, evaporates the extract to a syrup, exhausts with alcohol, decolorises the alcoholic solution with animal charcoal, and evaporates, whereupon the acetate of fumarine crystallises in needles. The crystals, when decomposed by an alkali, give a precipitate of fumarine, which crystallises from boiling alcohol. — Pommier precipitates the acetic extract with ammonia, dissolves the precipitate in hydrochloric acid, decolorises, and allows the solution to crystallise. From the hydrochlorate thus purified the fumarine is separated by ammonia. It forms white bitter alkaline crystals, only slightly soluble in water, and yields with acids frothing crystallisable salts. It is soluble in alcohol (Pommier, *Repert.* 2, 469; Hannon, *J. Chim. méd.* [3], 8, 705; *Pharm. Viertelj* 68; *Kopp's Jahresber.* 1852, 550).

18. Hederine. — From the seeds of the ivy. An extract of seeds, made with acidulated water, is precipitated with milk of

cipitable by basic acetate of lead; he believes, however, that he has obtained it in crystals, by the following process, from that portion of the decoction of the leaves which is not precipitated by the basic acetate. The decoction is precipitated with basic acetate of lead, which throws down leaf-green, chrysoretin, resin, and gum; the filtrate is treated with hydrosulphuric acid: and the precipitated sulphide of lead is exhausted with ether. The ethereal solution deposits, by spontaneous evaporation, white needles, having a nauseous bitter taste; fusible, combustible, neutral, insoluble in water, acetic acid, alkalis, and cold alcohol, but soluble in hot alcohol, ether, and chloroform. These needles are the active principle (Rau).

67. Spigelia Bitter. — Brown extract, contained in that portion of the aqueous extract of *Spigelia anthelmia* which is soluble in alcohol and not precipitable by neutral acetate of lead. According to Feneulle, it acts as a narcotic, but according to Ricord Madiana (*Br. Arch.* 25, 38) it does not possess this property. It is soluble in water and alcohol, insoluble in ether (Feneulle, *J. Pharm.* 9, 197).

68. Spilanthin. — Occurs in *Spilanthes oleracea* (*Handbuch.* viii, 68) at the time of flowering. It is taken up by ether from an alcoholic extract of the plant, and is obtained in crystals by evaporating the ethereal solution, dissolving the residue in a small quantity of absolute alcohol, adding water till turbidity is produced, and setting the solution aside. — White light needles, which run into a resinous mass when their solution in ether or alcohol is rapidly evaporated. Not precipitable by neutral acetate of lead (Walz, *N. Jahrb. Pharm.* 11, 283). Besides this body, the plant contains an acrid substance. See Buchner (*Repert.* 38, 366); Lassaigne (*J. Chim. méd.* 1, 261).

69. Tanacetin. — Obtained from *Summitates Tanaceti.* Prepared, according to Homolle, in the same manner as digitalin (xvi, 333). — Yellowish-white nodules and granules, inodorous, very bitter, and slightly acrid. When heated, it melts, turns brown, evolves an odour of melilot, and leaves charcoal. — Dissolves in cold oil of vitriol, forming a hyacinth-red solution. It is very slightly soluble in water, but imparts to the liquid its bitter taste. Soluble in ether and less freely so in alcohol (Leroy, *J. Chim. méd.* 21, 357).

70. Tanginin and Tangin-camphor. — From the fruit of *Tanginia madagascariensis.* When the fruit is freed from oil by expression, and afterwards exhausted with ether, that liquid takes up tangin-camphor. The residue gives up to alcohol the tanginin, together with an acid body not precipitable by lead-salts. — Tanginin is a reddish-brown, sticky, bitter extract, which reddens litmus and acts as a narcotic. It does not yield ammonia by dry distillation. The aqueous solution is precipitated white by chlorine, bluish-green by acids, reddish-brown by alkalis, and is coloured brown by ammonia; it is likewise precipitated by metallic salts. Tanginin is soluble in alcohol, insoluble in ether.

Tangin-camphor. — Shining, transparent laminæ, which deliquesce in the air and melt at a moderate heat, without volatilising. Neutral, very bitter and burning, poisonous; fatal to animals in small doses.

from nitrogen. Insoluble in water, and does not combine with . Soluble in alcohol, from which it is precipitated by water; ble in ether (O. Henry, *J. Pharm.* 10, 52).

. Taraxacin. — Obtained from the fresh milky juice of the root *raxacum officinale.* Polex heats the fresh juice to boiling, filters, oncentrates the filtrate, whereupon the taraxacin crystallises. It ified by recrystallisation from water or alcohol. White, easily e crystalline nodules, which have a bitter, somewhat acrid taste, when heated, without evolving ammonia, and dissolve in strong without coloration. It dissolves with difficulty in cold water, asily in boiling water, alcohol, and ether (Polex, *N. Br. Arch.*)). — Kromayer exhausted the coagulated juice with hot water, ted the aqueous liquid with animal charcoal, which took up the principle, and exhausted the charcoal with alcohol. On distilling e alcohol, precipitating the residual solution with basic acetate of removing lead by means of hydrosulphuric acid, and evaporat- he taraxacin remained as a colourless amorphous bitter mass nayer, *Die Bitterstoffe*, 97).

he albumin, coagulated by boiling the milk-sap, gives up to alcohol, cauliflower-like fusible nodules, which have an acrid taste and with difficulty. They are but little affected by nitric acid, dissolve of vitriol with yellow colour, carbonise when the solution is d, and are not precipitated from their alcoholic solution by basic te of lead. Easily soluble in alcohol and ether (Polex). These es appear to be identical with Kromayer's tasteless *taraxacerin*, contains 74·44 p. c. C., 12·69 H., and 12·87 O., corresponding to rmula $C^{40}H^{60}O^{5}$ (Kromayer).

2. Teucrium Bitter. — *From Teucrum Scordium.* — An aqueous on of the alcoholic extract of the plant is freed from substances itable by neutral acetate of lead, and from excess of lead, and rated; the bitter is extracted from the residue by ether. — Honey- w mass, triturable to a white powder after drying. Neutral. — ble in cold water and dilute sulphuric acid; slowly soluble in us ammonia and potash with golden-yellow colour; soluble in ol and ether (Winckler, *Repert.* 38, 252).

3. Vellarin. — From *Hydrocotyle Asiatica.* Bitter, strongly smell- il, which thickens on exposure to the air, dissolves in ammonia, , and weak spirit, but not in potash-ley (Lepine, *N. J. Pharm.* 7; *Chem. Centr.* 1855, 542; *Kopp's Jahresber.* 1855, 723).

4. Bitter principle of the berries of Viburnum Lantana. — crushed berries are boiled with milk of lime; the filtrate is alised with hydrochloric acid and concentrated, then agitated animal charcoal, which takes up the bitter principle and yields it to alcohol after washing and drying; and the alcoholic liquid is rated to a syrup, and freed from an acrid substance by agitation ether. Yellow hygroscopic extract, which dissolves in water, very bitter, and cannot be made to crystallise by dialysis (Enz, *n. Viertelj.* 12, 534).

5. Viburnin. — Obtained from the bark of the gueldar ro

proteic acid and soluble salts of nitric and saccharic acids, so that it probably contains these acids in combination (Berzelius, *Jahresber*, 19, 651). See also Xanthoproteic acid, p. 264.

On warming the liquid white of hens' eggs, glutin, or flesh with a mixture of 2 volumes of fuming *nitric acid* and 1 volume of strong *hydrochloric acid*, a violent frothing and evolution of nitric oxide takes place, and decomposition-products are formed, part of which pass over in the acid fumes, another portion separating from the acid solution on cooling, while a third portion remains dissolved. A very large excess of nitric acid destroys the products thus formed, and there remains, instead of them, only a small quantity of volatile crystals and a large quantity of oxalic acid.

To obtain these products, one of the proteides is dissolved in warm fuming nitric acid, with addition of water if necessary, and the solution is filtered, mixed with half its volume of strong hydrochloric acid, and distilled till the contents of the retort throw down a yellow waxy tough mass.

a. Oily drops of chorazol pass over with the acid vapours. They collect at the bottom of the receiver, and are afterwards purified by distillation with water and dried over chloride of calcium.

Chlorazol is a thin yellow oil, of sp. gr. 1·555, having a very powerful odour and an acid reaction, and acting as a poison. It explodes violently when heated. Dissolves very sparingly in water and does not take up water, but when it is left in contact therewith, its surface acquires a dull-white appearance. Dissolves freely in alcohol. — When this chlorazol, obtained by the treatment of the original product, is distilled alone, an evolution of hyponitric acid takes place, and at about 140° there passes over an oily body (*b*) resembling chlorazol but differing in composition and having the sp. gr. 1·628. Lastly, the volatile decomposition-products obtained in the first operation (see [illegible]) yield, by repeated treatment with nitric acid, oily bodies (*c* [illegible]) resembling chlorazol.

Analyses by Mühlhäuser.

	a.	*a.*	*b.*	*b.*	*c.*	*c.*	*d.*
C	18·91	19·44	12·77	13·98	12·03	12·78	[illegible]
H	1·72	2·90	1·19	1·75	1·07	1·13	[illegible]
Cl	40·19	44·98	56·88		38·40	38·50	[illegible]
N	11·80				13·10	15·70	

Calculations, according to Mühlhäuser.

	a.		*b.*		*c.*		*d.*
8 C	19·23	4 C	13·44	4 C	12·70	[illegible]	
3 H	1·20	2 H	1·12	2 H	1·06	[illegible]	
3 Cl	42·68	3 Cl	59·66	2 Cl	37·6	[illegible]	
2 N	11·22	N	7·84	2 N	14·8	[illegible]	
8 O	25·65	4 O	17·81	8 O	33·8	[illegible]	
	$C^8Cl^3X^2H^3$ 100·00		$C^4Cl^3XH^2$ 100·00		$C^4Cl^2X^2H^2$ 100·00		[illegible]

Strecker (*Handwörterb.* 2 Aufl. 2, 2, 166) regards [illegible] and *c* and *d* as essentially identical, probably having [illegible]. On this supposition both bodies are homologous [illegible] (xi. 216).

b. The residue in the retort deposits on cooling [illegible]

PRÉVOST & DUMAS. *Ann. Chim. Phys.* 23, 52.
J. VOGEL. *Ann. Pharm.* 30, 20; *Berzel. Jahresber.* 20, 549.
F. ROSE. *Pogg.* 28, 132.
MULDER. *Pogg.* 40, 271. — *J. pr. Chem.* 44, 489.
AD. WURTZ. *Compt. rend.* 18, 700; *J. pr. Chem.* 32, 503; *Berzel. Jahresber.* 25, 874.
MELSENS. *N. Ann. Chim. Phys.* 33, 170; *J. pr. Chem.* 54, 383; *Kopp's Jahresber.* 1851, 576. — *Belg. Acad. Bull.* 24, No. 2; *Instit.* 1857, 201; *Kopp's Jahresber.* 1857, 531.
LIEBERKÜHN. *Pogg.* 86, 117 and 298; *J. pr. Chem.* 57, 352; *Kopp's Jahresber.* 1851, 692.
THEILE. *Jenaer medic. Zeitschr.* 3, 147; *N. Br. Arch.* 138, 19; *Kopp's Jahresber.* 1867, 774.

White of egg. Albumin of birds' eggs. To be distinguished from serum albumin and vegetable albumin.

Forms the chief part of the organic substance of the white of birds' eggs, which is rendered viscid by the presence of the membranes permeating it, and contains, besides albumin, small quantities of albuminate and paraglobin, traces of fats or soaps, grape-sugar, and a quantity of ash amounting to about 3 p. c. of the solid constituents. — On crystals of an albuminous body from the white of hens' eggs, see Ar. Boettcher (*Virchow's Arch.* 32, 525; *Anal. Zeitschr.* 4, 262); on *Oonin*, a body separated from white of egg by freezing, see Couerbe (*J. Pharm.* 15, 497; *Ann. Chim. Phys.* 41, 323).

On differences between the whites of fowls' and pigeons' eggs, see Jahn (*N. Br. Arch.* 37, 259; *Berzel. Jahresber.* 25, 875).

On the formation of albumin or coagulable albuminous bodies from casein, according to Sullivan, see Casein.

According to Danilewski's preliminary communication (*Krit. Zeitschr. f. Chem.* [2], iv, 12, 41) there exists in the white of hens' eggs an optically inactive albumin containing 2 p. c. of sulphur, by the splitting up of which albuminous substances are obtained, having a left-handed rotatory action on polarised light. In these bodies the sulphur is said to be combined in part indirectly and in part directly with oxygen; but an albumin may be obtained in which the sulphur exists only in the latter state. Albumin containing 2 p. c. of sulphur, in being resolved into *a*, *b*, *c* albumin containing 1·3, 1·1, 0·9 p. c. of sulphur, yields at the same time fatty acids, neurine, and cholic acid as decomposition-products.

Preparation. The coagulated albumin employed for the analyses given below was prepared either by boiling filtered white of egg and washing the coagulum with water and alcohol (Mulder), or by precipitating filtered white of egg with alcohol, and washing with alcohol, water, and ether (Lassaigne, *Ann. Chim. Phys.* 20, 98; Dumas & Cahours, *N. Ann. Chim. Phys.* 6, 407; Theile). Rüling adds a few drops of hydrochloric acid before precipitating with alcohol.

Wurtz precipitates diluted and filtered white of egg with basic acetate of lead, not in excess; suspends the washed precipitate in water, and passes carbonic acid through the liquid; filters; precipitates traces of lead from the filtrate by a few drops of aqueous hydrosulphuric acid; and heats the clear brown liquid to 60°, whereupon the sulphide of lead goes down with the first flocks of albumin. He then filters again and evaporates the filtrate at 50°. According to Schmidt (*Würzburg medic. Zeitschr.* 5, 318) and Kühne (*Physiol. Chemie*), the albumin thus prepared contains acetic acid, and is precipitable by ammonia, and has therefore already undergone alteration.

Graham (*Ann. Pharm.* 121, 61; *Kopp's Jahresber.* 1861, 80) pr[illegible]

egg albumin by submitting to dialysis the white of hens' eggs mixed with acetic acid; after 3 or 4 days, albumin free from ash remains on the dialyser. It then possesses a slight acid reaction, coagulates milk heated with it, and still contains the sulphur pertaining to its constitution. Kühne was unable in this manner to get rid of the salts from serum albumin without at the same time rendering it insoluble. This albumin doubtless contains acetic acid.

Von Wittich (*J. pr. Chem.* 73, 18; *Kopp's Jahresber.* 1858, 541) dilutes white of egg with water, with addition of a little carbonate of soda; precipitates the albumin as acidalbumin by hydrochloric acid; collects the precipitate, and washes it with water containing hydrochloric acid; suspends it in water at 50°; precipitates the milky liquid with carbonate of ammonia; and washes the precipitate with water, cold alcohol, and ether. The egg albumin thus obtained is insoluble in water and neutral salts, also in bicarbonate and neutral phosphate of soda, but dissolves in aqueous neutral carbonate of soda and monophosphates of the alkalis, and combines with acids to form compounds which are soluble in pure water, and are precipitated on neutralising their solutions with alkalis. It is, therefore, at any rate, altered albumin, probably having been converted into syntonin (Kr.).

Hoppe-Seyler (*Anal. Zeitschr.* 3, 425; *Handb.* 186) cuts up white of egg with scissors; squeezes it through linen; filters without access of air to prevent incipient browning; dilutes with a large quantity of water; and precipitates a few flocks or fibres of an albuminous substance soluble in hydrochloric acid by careful addition of acetic acid, or by a current of carbonic acid. The filtrate may be freed from salts by dialysis or by Wurtz's method.

According to these experiments, and those given under serum albumin, albumin in a soluble state has not been obtained free from ash, and from acid or alkali, and hence the view put forward by Scherer, Denis (*Mémoire sur le sang*, 187), and others, viz., that egg albumin and animal albuminous substances generally are in themselves insoluble in water, and become soluble only after combination with salts or alkalis, appears to be well-founded. This view is further supported by the following statement of Kühne:—When white of hens' eggs is largely diluted with water, it deposits nearly the whole of the albumin held in solution by salts, whilst albuminate of potash and globulin remain in solution. After precipitating these also by careful addition of acetic acid, the filtrate becomes slightly turbid only on boiling, owing to the small quantity of albumin remaining dissolved in the very dilute saline liquid (Kühne, *Physiol. Chemie*, 553). Denis cites the following experiment: On diluting [illegible] white of egg with from 5 to 20 parts of water, and adding [illegible] very weak hydrochloric or acetic acid, a turbidity [illegible], which dissolves in water containing chloride [illegible] potash (Scherer)], and is reprecipitated [illegible] water. Eichwald (*Wurzburg. medi*[illegible] [illegible]umin as insoluble in water, and sol[illegible] [illegible]ir salts.

Properties. Dried al[illegible] translucent mass of co[illegible] Aqueous egg albumin [illegible] $[\alpha]\delta = 35{\cdot}5°$: hydro[illegible]

hours, dissolves therein, forming a solution which is precipitated by acids (Wöhler, *Ann. Pharm.* 41, 238). When it is heated to near 200° with water in a copper digester, the walls of the vessel become covered with a film of sulphide of copper, and the albumin dissolves, with exception of a portion which remains unaltered. The solution contains a little free acid, and substances partly soluble and partly insoluble in alcohol.—When coagulated albumin is boiled for some time in water, it swells up strongly, softens, decomposes, and gives up animal matters to the water (Gmelin).

Mulder (*Ann. Pharm.* 47, 314) found that when white of hens' eggs was boiled in a Papin's digester for 150 hours, there remained a portion insoluble in water and alcohol, containing 54·34 p. c. C., 15·33 N., and 7·16 H., unaltered albumin according to Mulder. The aqueous solution, when evaporated to dryness, left a residue which, after exhaustion with alcohol, dissolved in water and gave a precipitate with neutral acetate of lead, and a further precipitate with the neutral acetate and ammonia. Both precipitates were decomposed by hydrosulphuric acid. The substance thus obtained is Mulder's protein trioxide containing 50·75 to 51·36 p. c. C., 6·69 H., 15·01 N. It is neutral soluble in cold water, precipitable by dilute mineral acids, chlorine, and metallic salts, but not by acetic acid, ferrocyanide of potassium, chloride of ammonium, or chloride of barium.

Undiluted white of hens' eggs, when submitted to *electrolysis*, deposits a dense white layer of coagulated albumin at the positive pole, and if the experiment be continued long enough, the negative pole becomes covered with a clear jelly of albuminate of soda, which last does not appear with diluted albumin. Solutions of alkaline albuminates likewise deposit the albumin in films at the positive pole; acid solutions of albumin deposit it more slowly at the negative pole, in the form of a diffused cloud, whilst alkali or acid is set free at the opposite pole. If the solution contains free acid, free alkali, or monocarbonate or bicarbonate of alkali, the deposit of albumin does not take place, or takes place very slowly; but if the solution contains neutral salts, such as chloride of sodium, phosphate of soda, sulphate of soda, sulphate or nitrate of potash, the deposit at the positive pole is much more abundant (v. Wittich).—The following are older statements:—Albumin alone or diluted with water is completely coagulated at the negative pole (Arnim, *Gilb.* 8, 259; Marx, *Schweig.* 54, 209). With a strong current, a rapid deposit takes place at the negative, and a slower deposit at the positive pole; with a very weak current, there is a deposit at the positive pole, whilst an alkaline solution of albumin is formed at the negative (Brande, *Gilb.* 64, 354). With a weak current, C. G. Gmelin (*Gilb.* 64, 347) observed coagulated albumin at the positive pole only, never at the negative; a strong current caused coagulation at both poles, which Gmelin attributes to the heat evolved. Lassaigne (*Ann. Chim. Phys.* 20, 97) precipitated albumin with alcohol, washed the precipitate with weak spirit to free it from chlorides, and submitted its aqueous solution to electrolysis, which did not [illegible] coagulation excepting after addition of chloride of [illegible] only at the positive pole. According to Morin (*Pu*[illegible] 104) this result is due to the low conducting power [illegible] Morin's other statements agree with those of v. Wit[illegible] Golding Bird, see *Serum albumin*. According to Si[illegible]

f. Nitric acid throws down from aqueous solutions of albumin a white precipitate, which turns pasty and dissolves on washing, and is re-precipitated in yellow flocks by nitric acid in excess. The precipitate dissolves also in acetic acid, and, according to Thénard, in ammonia and potash, provided the nitric acid employed is not concentrated. The precipitation is the more complete the stronger the acid and the solution of albumin, and it is accelerated by warming. Very weak nitric acid turns yellow after some weeks, and converts the albumin into a yellow mass, which, after washing with cold water, dissolves in hot water and gelatinises on cooling (Hatschett).—Excess of nitric acid, on warming, dissolves albumin coagulated by heat, or by nitric acid itself, with evolution of nitric oxide, nitrogen, carbonic acid, and hydrocyanic acid. The solution is a dark-yellow liquid, which is precipitated by water, gives a dark-brown precipitate with ammonia, and after prolonged action of the nitric acid, contains oxalic acid (Hatschett). The solution contains an ammonia-salt, afterwards oxalic and saccharic acids, and leaves xanthoproteic acid when evaporated (Mulder). Liquid white of egg coagulates when mixed with half its volume of fuming nitric acid, becoming hot and yellow. On further heating, the mixture froths violently, evolves a large quantity of nitric oxide, and yields a clear solution, from which a small quantity of an amorphous substance is deposited on cooling (Mühlhäuser). See also the decomposition of proteides by nitric acid (pp. 257, 258).

g. Albumin dried at 130° is insoluble in *acetic acid* (Mulder).—Aqueous egg-albumin is not precipitated by excess of acetic acid, either in the cold or on boiling, but the acid solution is precipitated by neutralisation with carbonates of the alkalis (Berzelius). In this reaction, acetic albuminate is formed, which remains in solution in presence of small quantities of acetic acid, but gelatinises in presence of larger quantities (J. C. Lehmann).

When albumin is treated with *strong acetic acid*, it swells up to a jelly, which dissolves on addition of water, especially when warmed. On evaporating the solution, acetic acid is volatilised, the liquid becoming covered with froth, and solidifying to a jelly, which leaves coagulated albumin when evaporated to dryness (Berzelius). Albumin dried in the sun, or evaporated to ⅓rd its volume at 40°, coagulates when acetic acid is poured upon it, and, after washing away the acid, is then insoluble in water, but soluble in dilute acetic acid. Albumin purified by Wurtz's method behaves in the same way. The insoluble albumin thus formed contains, at 130°, 53·08 p. c. C., 7·19 H., and 1·706 S. (Lieberkühn, *Virch. Arch.* 5, 162).

The first effect of the action of acetic acid is to render the albumin precipitable by acids. On precipitating with acetic acid a solution of albumin mixed with chloride of sodium, and filtering off the precipitate at once, a filtrate is obtained which again becomes turbid on standing. The first precipitate is soluble in water, and is not thrown down on neutralising the solution, provided that the acid has not acted too long (Brücke).

The formation of acetic albuminate takes place even in [illegible] solutions; immediately in solutions which contain, after [illegible] of albumin (free from albuminate of soda and globulin) and [illegible] acetic acid, and in more dilute solutions after standing for [illegible] on heating to 40°. In such cases the solutions remain clear, [illegible]

after very prolonged washing the pieces become opaque, and are then insoluble in boiling water (Kühne, *Physiol. Chemie*, 175). This effect is due to carbonic acid in the water; in water free from carbonic acid the pieces melt from without inwards and dissolve (Brücke).

When a solution of albumin gelatinised by potash is treated several times with water, and afterwards boiled with alcohol, a solution is obtained, from which ether throws down a precipitate of albuminate of potash soluble in boiling water and alcohol; when dried, the precipitate becomes insoluble in both liquids, and is converted into an amber-yellow mass, difficult to powder. This mass, after washing with water, which still takes up potash, has the following composition (Lieberkühn).

	Dried at 120°.		Lieberkühn.
72 C	432	50·63	50·21
9 N	126	14·79	
56 H	56	6·56	6·65
22 O	176	20·63	
8	16	1·87	
KO	47·1	5·52	5·44
$C^{72}N^{9}H^{56}SO^{22},KO$	853·1	100·00	

1 part of soda combines with 4 parts of albumin to form albuminate of soda (v. Wittich).

Aqueous albuminate of potash does not coagulate at 140° (Hoppe-Seyler). — Solutions of alkaline albuminates, when carefully neutralised by *acids*, deposit the albuminic acid, which dissolves in excess of acids (Lieberkühn).

When solid albuminate of potash, cut in pieces, is immersed in so much aqueous *acid phosphate of lime*, or *phosphoric, boracic, hydrochloric*, or *acetic acid*, that the liquid still retains an acid reaction, the albuminate turns milk-white, begins to shrink, and solidifies to an elastic mass. The substance thus formed is Brücke's *Pseudofibrin;* it swells up to a glassy jelly, without dissolving, in water containing $\frac{1}{10}$th p. c. of phosphoric, acetic, or hydrochloric acid; dissolves easily in potash-solution; and swells up, becomes opaque, and dissolves in ammonia, from which it is precipitated by neutralisation (Brücke, *Virch. Arch.* 12, 193. — *Wien. Acad. Ber.* 2 Abth. 55, 881; *Chem. Centr.* 1867, 1005).

Carbonic acid also precipitates all alkaline albuminates (v. Wittich; J. C. Lehmann). It does not precipitate the natural albuminates (Kühne, p. 274). *Boracic acid* precipitates aqueous albuminate of potash completely (Brücke). *Nitric acid* throws down a precipitate which dissolves in the slightest excess of the acid, re-appears on adding more acid, dissolves on boiling, and is deposited in the form of a jelly as the solution cools. When *acetic acid* is added to a neutral solution of albuminate of potash till the precipitate formed at first just re-appears, the solution coagulates on boiling, or on addition of alcohol. On evaporating a solution containing excess of acetic, *lactic*, or *phosphoric acid*, there remains a residue, a solution of which in water forms pellicles when evaporated, is precipitated by acids (the precipitate dissolving in excess) and does not coagulate when heated, behaving, therefore, like caseïn (Lieberkühn).

When the alkaline solution of albumin has been boiled, the pr

ate produced in it by acetic acid is no longer soluble in excess of the acid. Sal-ammoniac precipitates the alkaline solution on boiling, and likewise precipitates a previously boiled solution in the cold (Gorup-Besanez, *Ann. Pharm.* 125, 122). An aqueous solution of albuminate of potash, to which a large quantity of chloride of sodium has been added, is precipitated on warming (Lieberkühn, *Virchow's Arch.* 5, 162).

The albuminic acid thrown down from alkaline solutions by acids dissolves easily in dilute acids and alkalis, and in aqueous solutions of neutral salts of the alkalis containing as much as 10 per cent. of the salts, provided it has not remained long under water or been boiled with water. The saline solutions are syrupy, and are precipitated by addition of water or acids, and by a boiling heat. Albuminic acid which has been boiled with water is insoluble in saline solutions and dilute acids; after being precipitated from alkaline solutions by acids, and left for some time under water, it dissolves with difficulty, and only when heated, in hydrochloric acid of 0·1 per cent. Albuminic acid is converted into syntonin in all acid solutions, so that the precipitate thrown down from these solutions on neutralisation is insoluble in neutral salts, and soluble only in caustic alkalis and their carbonates (Kühne, *Physiol. Chemie*, 176). Brücke (*Wien. Acad. Ber.* 2, Abth. 55, 881; *Chem. Centr.* 1867, 1003), found the precipitate produced in alkaline solutions of albumin on neutralisation to be insoluble in saline solutions, and more easily soluble in acids in proportion as the liquid was more free from salts.

When a solution of coagulated albumin in the smallest possible quantity of potash-solution, to which acetic acid is added till the precipitate disappears, is submitted to dialysis till it is no longer acid, there is left a slightly opalescent liquid which coagulates when heated and is precipitated by mineral acids, small quantities of alkalis, and neutral salts, and hence contains the albumin (albuminic acid) in a form analogous to that of Graham's soluble silicic acid (Schützenberger, *Par. Soc. Bull.* 1, 285; 5, 163). See also Hoppe-Seyler (*Anal. Zeitschr.* 3, 427).

The presence of *alkaline phosphates* in solutions of albuminate of potash prevents, to a certain extent, the precipitation by acids, including carbonic (Kühne; J. C. Lehmann) and boracic acids (Brücke), so that solutions are obtained which redden litmus, and, after addition of more acid, throw down a precipitate soluble in excess of the acid. When albuminate of potash is mixed with phosphate of soda or potash and then with dilute acids (acetic, lactic, phosphoric, hydrochloric, or nitric), drop by drop, till the solution exhibits an acid reaction and begins to appear opalescent, the addition of ferrocyanide of potassium produces no precipitate. The solution rendered opalescent by a rather larger quantity of acid, does not undergo alteration at ordinary temperatures; it becomes [illegible] but still contains albumin in solution at 100°. Wh[illegible] solution of albuminate of potash containing al[illegible] with sufficient acid to redissolve the preci[illegible] solution is formed from which ferrocyanide of [illegible] albu[illegible] precipitate. [illegible] h till in- [illegible] hosphate [illegible] y ferro- [illegible] Centr.

	Rüling.		Völckel.
	15.	16.	17.
	140°.	140°.	140°.
C	53·35	53·71	53·43
H	7·11	7·09	7·12
N			15·36
Ash deducted	1·40		0·32

Remarks on the analyses. — 1. Mulder's casein (1) was precipitated by acetic acid; 2 by heat from buttermilk. The sulphur determinations—0·36 and 0·10 p. c. respectively—were made by dissolving the casein in nitric acid, and precipitating with baryta, and are therefore incorrect; so are probably also the phosphoric acid determinations, according to which (1) contained 1·570, while (2) contained 1·35 p. c. of phosphoric acid. The casein of boiled milk is, according to Mulder, altered casein. 3—7. Schorer analysed (3) the pellicle of casein formed on evaporating milk; (4) casein precipitated by alcohol; (5) the coagulum produced on heating sour uncurdled milk; (6) casein precipitated by acetic acid, and purified by dissolving it in carbonate of soda and reprecipitating with acetic acid; (7) that portion of the casein of milk which remains in solution when milk turns sour, and coagulates on boiling. In all cases the casein was purified by exhaustion with boiling alcohol and ether. — 8 and 9. Rosdeleder's analysis (8) gives the mean percentages of carbon and hydrogen contained in casein precipitated from sulphuric solution by sulphuric acid, by acetic acid; and by carbonate of soda; (9) is the same, but dried at 100° for three days.

10—14. Dumas & Cahours precipitated their casein at the boiling-heat by acetic acid, excepting that from human milk, which was precipitated by alcohol. — 15 and 16. Rüling's casein. (15) was obtained from new milk, (16) from new cheese. Völckel's casein contained also 0·74 p. c. of phosphorus.

The proportion of sulphur in casein was found to be 0·85 to 1·017 p. c. (Rüling, *Ann. Pharm.* 58, 319), 0·843 p. c. (Verdeil, *Ann. Pharm.* 58, 319), 0·933 p. c. (Walther, *Ann. Pharm.* 58, 315), 1·11 p. c. (Völckel), and, lastly, 0·9 to 1·1 p. c. (Schwarzenbach, *Ann. Pharm.* 133, 191). Hence, as Schwarzenbach points out, casein contains half as much sulphur as egg albumin.

From the experiments of Lubavin (*Medicin. Centralbl.* 1871, 463), it appears that casein, like vitellin or haemoglobin, is a compound of an albuminous or proteid compound with a non-albuminous body. When digested with artificial gastric juice, it yields a body containing phosphorus, whereas albuminate can be prepared from white of egg, which contains no phosphorus: hence casein is not identical with albuminate prepared from the other albuminous bodies. (See p. 303—306.)

Decompositions. 1. Curd thrown down by rennet and dried yields by *dry distillation* the same products as gelatin, leaving charcoal containing phosphates (Schübler; Berzelius). — 2. *Ozonised air* passed into solution of casein produces neither precipitate nor coloration, but when the current is continued for some time, the solution becomes coagulable by boiling or by nitric acid. Afterwards the albuminous substance thus coagulable is also destroyed, and there then remain the same products as are formed in the case of albumin (*Gorup-Besanez, Ann. Pharm.* 110, 100). — 3. Casein subjected to prolonged boiling with water, [illegible] with access of air, [illegible]d to 108° with water, yields the

On heating a solution of casein in weak potash-ley till the precipitate produced by acetic acid in a hot test-portion of the liquid melts to a resinous mass and dissolves in alcohol, and then precipitating the hot solution with acetic acid, there is thrown down a white or yellow viscid body, which is nearly free from sulphur, and afterwards hardens to a yellowish-brown mass in the air. This body dissolves in water and is precipitated from the solution by acids; it forms with boiling alcohol a turbid liquid, from which it is deposited again on cooling. Boiling baryta-water dissolves it, forming a crystalline and an amorphous compound, from solutions of which acids throw down a curdy precipitate (Laskowski, *Ann. Pharm.* 58, 169).

When casein is melted with its own weight of hydrate of potash, according to nill, 358, till not only ammonia but also hydrogen is evolved, the following products are formed: tyrosine, leucine, and, as decomposition-product of the latter, valerianic acid (or by prolonged fusion, butyric acid); also oxalic acid and a volatile substance which smells like faeces and reduces oxide of silver, but no formic acid (Liebig, *Ann. Pharm.* 57, 127; Bopp *Ann. Pharm.* 69, 20). Leucine is formed very early, tyrosine only later (Bopp).

10. When casein covered with water is exposed to the air for several months in summer, *putrefaction* takes place, and the following volatile bodies are formed: carbonic acid, hydrosulphuric acid, ammonia, butyric acid, valerianic acid, and an oily body easily alterable by air or by acids; leucine is also formed as a non-volatile product. A portion of the casein dissolves under the influence of the ammonia produced (Iljenko, *Ann. Pharm.* 63, 264; *Kopp's Jahresber.* 1847 and 1848, 839). Similar observations were made by Bopp. See Albumin. Beaumont (*Ann. Chim. Phys.* 35, 159), and Proust (*Ann. Chim. Phys.* 10, 29) previously investigated the products formed by the putrefaction of cheese (not pure casein). See *Leucine* xi, 425. — Even in the ripening of cheese, the casein becomes altered, with formation of ammonia and leucine, but it is not converted into fat as stated by Blondeau. See Blondeau (*Compt. rend.* 25, 340); further *Ann. Chim. Phys.* (4, 1, 208); Brassier (*Ann. Chim. Phys.* (4) 5, 270; *Chem. Centr.* 1865, 888). In a strongly smelling Limburg cheese, Iljenko and Laskowski (*Ann. Pharm.* 55, 78) found volatile fatty acids and unaltered casein. — On addition of carbonate of ammonia or of chalk, the putrefaction of casein proceeds in the same way as that of fibrin (Brendecke).

When milk is milked into glass vessels which are immediately closed air-tight, it deposits, after some time only, a [illegible] which afterwards re-dissolves, so that the then nearly [illegible] contains only butter and a little coagulated casein [illegible] filtrate obtained after two years' standing does not [illegible] tion of casein when evaporated; it is precipitated [illegible] ammoniac, chloride of sodium, chloride of pot[illegible] soda, sulphate of potash, and saltpet[illegible] precipit[illegible] same salts at low temperatures are s[illegible] in water [illegible] coagulable by heat (Sullivan, *Phil. Mag.* [illegible] 203; [illegible]

11. On adding to milk, at 30° to [illegible] is, the mucous membrane of the stom[illegible] liquid, dried, and again softened in wa[illegible]

the lapse of a few hours, in the form of a coherent tremulous jelly (ordinary cheese), which, after pressing, is white and elastic, and readily cakes together (Schübler). In this process there remains in solution a body precipitable by acetic acid at 75° to 100°, which Schübler distinguished from casein as *Zieger*. Gmelin, Bergsma, Berzelius, and Fr. Simon agree in regarding *Zieger* as casein, which is retained in solution, according to Bergsma, by free acid, or, according to Simon, by alkali. — The casein of Denis is not coagulated by rennet, except after addition of whey.

According to Simon, rennet acts by first forming lactic acid, which then decomposes the casein-alkali of the milk: hence the formation of curds and the acidification of the liquid take place simultaneously at 37° to 43° (Simon). According to Selmi (*N. J. Pharm.* 9, 265; *Berzel. Jahresber.* 27, 635), however, solutions of oxalate and acetate of casein are likewise coagulated by rennet; whilst milk having an alkaline reaction, or mixed with alkali, yields alkaline curds and alkaline whey, when heated to 50° or 56° with rennet. Heintz (*Zoochemie*, 687) found both these statements to be correct, the difference in the results of experiment being due to differences in temperature. Milk is rendered acid by rennet at about 40°, but at 54° to 62° it may be coagulated without being rendered acid. According to Kühne (*Physiol. Chemie*, 567), a partial separation only of the casein took place in these experiments, such as is produced by the smallest quantity of acid at these high temperatures, the liquid again acquiring an alkaline reaction. See also Klunk (*Dissert. über die Coagulation der Milch durch Labflussigkeit*, Giessen, 1863; *Jahresber.* 1863, 648).

The coagulation of milk takes place the more rapidly the longer the rennet has been in contact with air and water; the mucous membrane when perfectly fresh is almost without action. — Curds coagulated by rennet are insoluble in alkaline carbonates, or dissolve only after prolonged boiling, owing to the presence of phosphates of lime and magnesia. When treated with sulphuric acid, they deposit the earthy phosphates (Liebig, *Handwörterbuch*, 3, 229).

Combinations. Casein is insoluble in *water*. The soluble casein of the older chemists is mostly casein-alkali. One part of Rochleder's casein remained in solution in 422 parts of cold water, when the solution was prepared by boiling.

With Acids. — Solutions of casein in alkalis are precipitated by acids, with the [illegible] carbonic acid (Rochleder), and phosphoric acid (Braconnot). [illegible] of alkaline phosphates, they are precipitated by [illegible] acids; in presence of phosphates an excess of acid is [illegible]

All precipit[illegible] by acids from alkaline solutions of casein (includ[illegible] by hydriodic, perchloric, sulphocyanic, and [illegible] compounds of casein with the acids; they are [illegible] the nitric acid compound most [illegible] in acid in aqueous [illegible] goes down with [illegible] sulphate, phos- [illegible] alkali, and nitric [illegible] precipitated; and

strongly alkaline solution, and is partially prevented only by a large excess of soda. On cautiously adding dilute acetic acid to the solution, it deposits flocks which in a few minutes combine to form fibrin. Excess of acetic acid re-dissolves the flocks completely, whereupon ferrocyanide of potassium and chloride of sodium throw down precipitates (Eichwald).

On Schmidt's fibrinoplastic substance, see Paraglobin (p. 271). His *fibrinogenous substance* is obtained as follows :—

Some liquid containing both these fibrin-forming substances (the diluted plasma of horse's blood, for instance) is first freed from fibrinoplasmin by a current of carbonic acid. The fibrinogen may then be precipitated from the filtrate in flocks, by concentrating it in a vacuum, dropping in alcohol till turbidity is produced, and setting aside for some hours. It must be remembered that, inasmuch as alcohol promotes the formation of fibrin, the precipitate may, under certain circumstances consist of fibrin, and, moreover, that too much alcohol precipitates also serum albumin. The latter applies more particularly to the use of transudations.

The fibrinogenous, like the fibrinoplastic substance, is precipitated by a current of carbonic acid, but much less rapidly and easily, so that the mode of preparation described under fibrinoplasmin may likewise be adopted for the preparation of fibrinogen from transudations. A further consequence of this behaviour of the two substances is that the precipitate produced by carbonic acid in diluted blood-plasma contains also fibrinogen, and therefore coagulates in the course of a few hours from very faintly alkaline solutions.

Fibrinogen thrown down by alcohol forms a finely granular, readily coherent precipitate, which dissolves somewhat less easily than fibrinoplasmin in alkaline water, but otherwise dissolves and reacts like fibrinoplasmin.—It decomposes peroxide of hydrogen in neutral or slightly acid solution very rapidly, the action ceasing however at 72° (Giannuzzi).

The two fibrin-forming substances are, therefore, characterized chiefly by their action upon each other. Whilst neither the fibrinoplastic nor the fibrinogenous substance in slightly alkaline solution, deposits fibrin on standing, the formation of fibrin takes place, with liberation of alkali, on mixing the solutions. In performing this experiment it is best to employ an artificially formed solution of one, and a natural solution of the other of these substances, as, for instance, blood-serum containing fibrinoplasmin, and fibrinogen dissolved in alkaline water,—or, conversely, transudations containing fibrinogen, and artificially dissolved fibrinoplasmin. The coagulation seldom takes place with solutions both of which are artificially prepared. Moreover, solutions otherwise suitable do not coagulate when acid or too strongly alkaline, or when they contain large quantities of neutral salts (Al. Schmidt).

According to Eichwald, pericardial fluids (which, according to Al. Schmidt, contain little or no fibrinoplastic substance) invariably deposit fibrin on standing. This deposition is accelerated by a current of carbonic acid, or by partially neutralising the strong alkaline liquid with phosphoric, hydrochloric, or acetic acid. On diluting pericardial fluid—previously freed from fibrin by passing carbonic acid into it and filtering—with 10 to 20 times its volume of water, and again treating

ing a solution which is not precipitated by excess of phosphoric acid (Berzelius).

On digesting 6 grammes of fibrin with a mixture of 20 grammes of water and 0·2 gramme of phosphoric acid of sp. gr. 1·845 at the temperature of 40° to 45° for 12 hours, the fibrin swells slightly; the acid liquid is not precipitated by boiling, but gives a permanent precipitate with nitric acid in not too small quantity, and is precipitated also by alcohol and by tannic acid. Acid phosphate of lime behaves in a similar manner (Guibourt).

8. *Nitric acid* colours fibrin yellow and forms products similar to those formed by sulphuric acid. On digestion, xanthoproteic acid is produced.

9. Dry fibrin swells up in fuming *hydrochloric acid* to a jelly, which gradually dissolves to a fine dark-blue liquid (Berzelius). 100 parts of dry fibrin take up at 15°, 7·16 parts of hydrochloric acid gas (Mulder). Prolonged boiling with the fuming acid generates the same products as with albumin and casein (Bopp).

In hydrochloric acid containing $\frac{1}{1000}$ to $\frac{5}{1000}$ of the acid, fibrin swells up to a glassy transparent mass, without dissolving. This mass shrinks to its original bulk and becomes opaque again when immersed in stronger acid (Liebig), or when washed free from acid with water, or neutralised; also on the addition of salts. The fibrin dissolves as syntonin, with the exception of a slight residue, on standing for a day at 20°, or in a few hours at 40°, and rapidly at 60° (Kühne). The undissolved portion is Bouchardat's epidermose; the solution contains his albuminose and gelatin (Bouchardat).

According to Guibourt (*J. Pharm. Chim.* [4] 2, 94) aqueous hydrochloric acid containing $\frac{1}{2000}$th of the acid appears to be best adapted for the solution of fibrin, 100 grammes of acid of this strength almost completely dissolving 4 grammes of moist fibrin in 12 hours, at the temperature of 40° to 45°. In other experiments of the same duration and at the same temperature, acid containing $\frac{5}{10000}$ths and $\frac{8}{10000}$ths caused little or no swelling of the fibrin; acid containing $\frac{24}{10000}$ths produced decomposition and partial solution; whilst in acid of 1·2 p. c. the fibrin contracted without dissolving. In the solutions thus formed nitric acid produced abundant white precipitates; only those liquids formed by imperfect swelling up of the fibrin became turbid on addition of alcohol or on boiling.

The hydrochloric acid solution gives with carbonate of ammonia a precipitate which, after treatment with alcohol, contains 52·92 p. c. C., 6·81 H., and 15·88 N. (Mulder & Baumhauer). According to Mulder, this precipitate is protein-binoxide. But air takes no part in the solution of fibrin by hydrochloric acid; moreover, the so-called protein-binoxide contains sulphur and phosphate of lime (Liebig).

Chloride of sodium, sulphate of soda, and nitrate of potash throw down from the solution of fibrin in hydrochloric acid a coagulum which, after washing with saturated solution of chloride of sodium, contains the sulphur and phosphate of lime of the fibrin (Liebig).

Fibrin dissolves more rapidly in a mixture of water, hydrochloric acid, phosphoric acid, and phosphate of lime, than in dilute hydrochloric acid (Brücke, *Wien. Acad. Ber.* 43 [2], 619).

10. Strong *acetic acid* converts fibrin into a colourless jelly which dissolves easily in warm water. The solution when evaporated becomes covered with a pellicle and afterwards gelatinises: when the evaporation is continued to dryness, the fibrin is left nearly free from acetic acid, opaque, and insoluble in water either cold or warm. Other acids

throw down from the acetic solution compounds of fibrin with the acids (Berzelius).

Acetic, citric, and tartaric acids act less powerfully upon fibrin at 40° to 45°, in twelve hours, than hydrochloric and lactic acids: only solutions containing at least 1 p. c. of these acids caused any considerable swelling up of the fibrin, a substance precipitable by acetic acid being then dissolved. In a solution of lactic acid containing only 0·6 p. c., under similar circumstances, fibrin swells up to a jelly which yields by filtration a liquid precipitable by acetic acid but not by boiling or by alcohol (Guibourt).

11. When fibrin is digested for a few days in a mixture of 1·3 grammes of *hydrochloric acid* with a litre of water (whereby it is rendered gelatinous without being dissolved), [illegible], and water is added, it dissolves completely in 24 hours at 15°, or in 4 or 5 hours at 30° to 40°, forming a colourless liquid which gives abundant precipitates with acids and alum, is not coagulated by heat, and when evaporated in a vacuum, leaves a pale-yellow residue soluble in warm water (Dumas, *Berzel. Jahresber.* 23, 472). See below the action of pepsin.

12. Moist fibrin soon begins to *putrify* in moist air, and becomes fluid in a week (Wurtz): under water it loses its cohesion and dissolves, in the course of three weeks, to a nearly colourless liquid containing flocks of sulphide of iron. In the decomposition, volatile badly-smelling products are evolved, together with a little hydrogen. The residual liquid coagulates like albumin when heated, a small quantity of nitrogenous substance remaining in solution (Liebig). The products of putrefaction are the same as in the case of albumin (p. 265) (Bopp).

The albuminous substance thrown down by heat contains, when dried at 130°, 53·9 p. c. C., 15·58 N., 6·99 H., 1·32 S., and 0·26 ash (Liebig). It may be isolated by means of basic acetate of lead and carbonic acid, like egg albumin (Wurtz). On prolonged putrefaction it becomes casein-like, so that an ammoniacal solution, when neutralised with acetic acid and freed from albumin by boiling, gives a second precipitate on further addition of acetic acid. This casein dissolves in excess of acetic acid; it is not precipitated by boiling with chloride of calcium or sulphate of magnesia; it is coagulated by rennet only after addition of milk-sugar, and does not form a casein-pellicle when evaporated (Gunning, *J. pr. Chem.* 67, 52; *Kopp's Jahresber.* 1856, 694).

The putrefaction of moist fibrin is not attended with formation of fat (Gay-Lussac, *Ann. Chim. Phys.* 4, 71, Wurtz). The products formed include a large quantity of butyric acid (Wurtz, *N. Ann. Chim. Phys.* 11, 253). — No fat is produced when carbonate of [illegible] chalk is added to putrefying fibrin: the dark-grey stinking [illegible] contains volatile fatty acids, and a small quantity of [illegible] probably capric (Brendecke, *N. Br. Arch.* 70, 26).

13. Fibrin behaves with aqueous *ammonia* as with [illegible] decomposition and solution take place more slowly; [illegible] solution, insoluble fibrin remains behind (Berzelius).

14. When fibrin is placed in very dilute *potash-l*[illegible] a jelly, which completely fills the liquid, and whe[illegible] 60° in closed vessels, gradually dissolves to a [illegible]

divided cholesterin, which takes up the pepsin. This emulsion is collected, washed with water containing acetic acid and with pure water, and lastly agitated with ether free from alcohol so long as it gives up cholesterin. The pepsin then remains in aqueous solution, which is to be freed from ether by exposure to the air and from a little mucus by filtration.

Gastric juice obtained from a fistula in the stomach of a dog by mechanical or electrical irritation of the empty stomach, may, provided it contains no albumin or acidalbumin, be freed from acid, salts, and peptones by dialysis, the pepsin then remaining behind on the dialyser (Krasilnikow, *Tübing. medic. Untersuch.* 1, 240).

Aqueous pepsin is colourless and neutral, and is not affected by strong nitric acid, tincture of iodine, corrosive sublimate, nitrate of silver, or tannic acid. It produces a turbidity in neutral acetate of lead, even when acidified with acetic acid; also in basic acetate of lead and bichloride of platinum. One drop added to 5 c.c. of aqueous acid containing 0·1 p. c. of hydrochloric acid, dissolves a flock of fibrin in the course of an hour. Finely divided phosphate of lime, animal charcoal, and sulphur, withdraw pepsin from its aqueous solution (Brücke).

Mucin.

FIGUIER. *J. Pharm.* 26, 113.
GOBLEY. *N. J. Pharm.* 33, 161.
ROLLET. *Wien. Acad. Ber.* 39, 308; *Chem. Centr.* 1860, 401; *Jahresber.* 1860, 567.
E. EICHWALD, jun. *Würzb. medic. Zeitschr.* 5, 281; *Ann. Pharm.* 134, 177; *Chem. Centr.* 1866, 209; *Jahresber.* 1865, 649.

To be distinguished from the mucin of wheat-gluten.

Source and Formation. 1. In the vineyard snail (*Helix pomatia*), the mucus of which was previously examined by Figuier and Gobley (Eichwald.) On the mucus of *Limax agrestis* and limacin, see below.

2. In many mucous fluids of the animal organism, especially in the fluid contents of colloïd sacs, in the mucous secretion of the respiratory passages, in lymph glands, salivary glands, sarcomas, and fibroids (Eichwald). Hence the products investigated by Scherer, Kemp, Gorup-Besanez, Städeler, and Cramer belong to this place, notwithstanding their divergent composition. See below.

3. The intercellular substance of connective tissue yields mucin by treatment with lime-water (Rollet; Eichwald).

Preparation. A. *From Vineyard Snails.* The snails freed from shells and cut up, are triturated with sand to a pulp, which is boiled with water. The liquid is filtered hot, and the dirty brown filtrate, which contains mucin and albumin-peptones, but no albumin, is precipitated with excess of acetic acid. The precipitate is washed by decantation, first with water containing acetic acid, and afterwards, when the washings are no longer rendered turbid by tannic acid, with pure water, to free it from acid. It is then dissolved in dilute lime-water,

and again precipitated with a large excess of acetic acid. The flocks thereby thrown down are again washed with dilute acetic acid, so long as the washings contain lime, hydrochloric acid, or peptone precipitable by tannic acid, and then with pure water till the mucin begins to swell up and run turbid through the filter. Strong spirit is then poured upon them, and they are preserved in that liquid (Eichwald).

B. Eichwald obtained mucin from mucous *fluids of the animal organism* in the same way as from snails. Such liquids, however, when thin, require to be warmed to 40° after precipitation with acetic acid, whilst thicker or viscid masses must be suspended in water before precipitation. The mucin thrown down often contains much albumin, and in that case is to be washed with water containing acetic acid till the washings cease to precipitate ferrocyanide of potassium or tannic acid. Sometimes it contains also plastic elements, which cannot always be separated by filtration, but only by deposition and decantation.

C. *From the connective tissue of the higher animals.* Sinews cut into fine shavings are freed from albumin and albuminates of the alkalis by washing with warm water and pressing in linen cloths till the washings are no longer precipitated by acetic acid and ferrocyanide of potassium. The residue is then digested with lime-water, in which the sinews swell up and become disintegrated; and after standing for 12 hours the product is exhausted two or three times more with lime-water. The filtered extracts are precipitated with a large excess of strong acetic acid, and the flocks of mucin thereby thrown down are purified by again dissolving them in lime-water and precipitating as before, and finally by washing them in closed vessels (Eichwald; Rollet). If the acetic acid employed be dilute or in too small quantity, the liquid is difficult to filter, and albumin is thrown down with the mucin (Eichwald).

Mucin is pure if, when it is mixed with water and acetic acid, and filtered, the filtrate gives no precipitate with ferrocyanide of potassium or tannic acid.

Properties. The mucin of snails, precipitated with alcohol, forms dense brown-grey flocks; that obtained from tissues or animal fluids is white or greyish-white. — After drying it forms a brown gelatine-like mass, difficult to pulverise (Eichwald).

	Kemp.	Mulder.	Scherer. a.	Scherer. b.	Gorup-Besanez.	Cramer, at 120°—130°.	Eichwald. 130°.
C	52·00	50·78	52·18	50·62	[illegible]	[illegible]	[illegible]
N	14·54	9·42	12·64	10·01	[illegible]		[illegible]
H	7·80	6·65	7·01	6·58	[illegible]		[illegible]
O	25·66	33·15	28·17	32·79	[illegible]		
	100·00	100·00	100·00	100·00			

Scherer's mucin was obtained from a large [illegible] gus of a man. — The viscid ropy contents [illegible] described in Lehmann's Physiol. Chemistry [illegible] warm water, filtered, and precipitated with [illegible] which was purified by boiling it with alcohol [illegible] alcohol, drying, triturating, and exhausting [illegible] white, friable, free from sulphur, soluble in [illegible]

chlorine when heated or when treated with oil of vitriol, and dissolve in alkalis with formation of metallic chlorides, and in hot nitric or acetic acid, from which they are deposited on cooling, but are insoluble in boiling water and alcohol (Thénard, *Mém. d'Arcueil*, 2, 38). When chlorine is passed into a solution of gelatin, the gas-bubbles become covered with a white froth, which collects in flocks on the surface of the liquid: the liquid, which appears milky at first, afterwards deposits a semi-transparent jelly, and then contains hydrochloric acid. *a.* The precipitated jelly contains 80·3 p. c. of gelatin and 19·7 p. c. ClO^3.—*b.* The floating flocks are white and tough, and contain, in the moist state, 75 p. c. of gelatin and 25 p. c. ClO^3. They give off a large quantity of chlorous acid at ordinary temperatures and turn brown at 100°. When dried, first at 30° to 40° and then at 100°, they are converted into a white, inodorous, friable mass of constant composition (see below), insoluble in water and alcohol. Their solution in ammonia evolves nitrogen, and when evaporated leaves sal-ammoniac and gelatin, the latter still having the composition and properties of the gelatin originally employed (Mulder, *Bullet. en Neerlande*, 1839, 153; *Berzel. Jahresber.* 19, 729).

Mulder (C = 75·54).

C	46·66		46·25
N	15·59		
H	5·90		5·81
O	23·37		
ClO^3	8·48		8·47

From fish-gelatin, whether boiled with water for 55 or for 100 hours, Mulder & van Goudoever obtained, by treating it with chlorine, a compound containing, at 110°, 43·16 p. c. C., 5·65 H., and 13·23 ClO^3. See also Mulder (*Ann. Pharm.* 46, 205; *Berzel. Jahresber.* 24, 711).

8. When 1 part of gelatin in powder is mixed with 2 parts of *oil of vitriol*, the mixture remains uncoloured for 24 hours: on now adding 8 parts of water and boiling for 5 hours, the water evaporated being replaced, glycogen, leucine, a body poor in nitrogen, and precipitable by tannic acid, and an ammonia-salt are formed (Braconnot). Fish-gelatin, boiled for some days with dilute sulphuric acid, yields sulphate of ammonia and fermentable sugar (Gerhardt, *Traité*, 4, 509).—8. Fuming *nitric acid* dissolves gelatin, with evolution of nitrogen, a little nitric oxide, and carbonic acid, and formation of oxalic and malic acids and fat (Scheele). Very weak nitric acid dissolves gelatin without evolution of nitric oxide, forming a yellow liquid which explodes when evaporated (Hatschett). Gelatin heated with an equal weight of water and one-fifth of nitric acid till it effervesces, and then cooled, forms Dumoulin's fluid gelatin (*Compt. rend.* 35, 444; *J. pr. Chem.* 58, 59).—Gelatin is not decomposed by boiling with aqueous *iodic acid* (Millon).

9. Other acids act like nitric acid in depriving gelatin of its property of gelatinising on cooling. *a.* Strong acetic acid [illegible] gelatin softened in water, and destroys its property of g[illegible] not its agglutinating power on drying.—*b.* When gelat[illegible] to swell in cold aqueous oxalic acid, and cautiously wa[illegible] mass remains fluid on cooling, then shaken with carbona[illegible] remove oxalic acid, and filtered, a neutral tasteless solution

which does not readily undergo putrefaction. It forms Carey Lea's *metagelatin.*

10. Gelatin boiled with *potash-ley* yields a large quantity of glycine and less leucine (Mulder, *J. pr. Chem.* 16, 290).—Heated with *potassium* or *sodium*, it oxidises slowly and carbonises without evolution of light (Gay-Lussac & Thénard).

11. A piece of gelatin placed in acid *mercuric nitrate* gradually turns red and dissolves to a fine red liquid, which becomes darker when boiled, and is turned dirty-yellow by chlorate of potash. *Mercurous nitrate* dissolves gelatin with yellow colour on boiling. Metagelatin behaves in a similar manner (Carey Lea, *Sill. Amer. J.* [2] 40, 81; *J. pr. Chem.* 97, 58). Nicklès (*J. Pharm.* [4] 3, 152) believes the red colour to be due to adhering albumin. See p. 262.

Combinations. Gelatin prepared from the skins of old animals swells up in water to a soft, sticky, translucent mass, without dissolving to any great extent: that prepared from the skins of younger animals, or from feet, sinews, or isinglass, dissolves partially or entirely in a larger quantity of cold water. With warm water it rapidly forms a perfect solution, which solidifies to a transparent jelly on cooling, provided it contains at least $\frac{1}{150}$th of gelatin.—The solidification of very dilute solutions of gelatin is prevented by vigorous and prolonged shaking, the cold solution then forming a syrup (Kühne). Isinglass gelatin retains its solubility in hot water after boiling with alcohol and drying at 125°: gelatin from stag's horn is not soluble after being thus treated (Mulder).

Hydrochloric, acetic, and other *dilute acids* dissolve gelatin without decomposition (Hatschett), and produce no precipitate in its aqueous solution (J. Muller). When added in very small quantity to water, they effect the dissolution of gelatin, even in the cold (Kühne). Solutions of gelatin are precipitated by *hydriodic acid*, but not by *iodine* or *iodic acid* (Vauquelin).

Gelatin purified by Graham's process of dialysis, combines with colloïd acids, and was hence termed by Graham a colloïd base. Thus, on dropping *metasphosphoric acid* into aqueous gelatin, a semitransparent, soft, elastic mass is thrown down, resembling fibrin, and containing 3·6 parts of acid to 100 of gelatin (Graham).

Graham's colloïd *silica* throws down from excess of aqueous gelatin white flocks which are not decomposed by washing do not putrefy, and contain 100 parts of silica to about 92 parts of gelatin. On adding gelatin-solution to excess of silica, a compound of 100 parts of silica with 56 parts of gelatin is [illegible] (Graham, *Chem. Soc. J.* xv, 246; *Ann. Pharm.* 121, 40).

Hot aqueous *potash* [illegible] gelatin, without evolution of ammonia, forming a brow[illegible] by acids (Hatschett). *caustic lime* and *phosphat*[illegible] aqueous gelatin (Vauquelin, *J. Phys.* 85, 127).

Gelatin [illegible] a mixture of alum and salt (J. Mul[illegible] down a compound of gelatin [illegible] of zirconium likewise precipitate[illegible]

Gelat[illegible] coagulum, which di[illegible] lution of

The constituents of the silk of the Chinese oak-spinner, the Jama-may silk of commerce, are the same as those of the silk of *Bombyx mori* (Bolley).

The cocoon of indigenous Bombyx caterpillars exhibits the same characters as silk (Schlossberger). Gossamer threads contain 15·25 p. c. fibroïn, also albumin (see above), jelly, cerin and solid fat (Mulder, *Pogg. Ann.* 39, 408). Spider-threads react like fibroïn (Schlossberger, *Ann. Pharm.* 110, 245).

Preparation. 1. Raw silk is boiled with strong acetic acid, and the undissolved portion is washed till it no longer exhibits an acid reaction (Mulder). — 2. Yellow raw silk is boiled in a Papin's digester for two or three hours six times in succession with water at 133°; the extracts containing the silk-gelatin are removed; and the residue is freed from colouring matter by treatment with strong alcohol, and from small quantities of fat by ether. Silk thus treated yields 66 p. c. fibroïn (Cramer). — 3. Yellow raw silk is immersed in cold soda-ley of 5 p. c.; the solution is expressed after 18 hours; the silk, which has become colourless, is washed first with pure water, then with water containing hydrochloric acid (1 pt. of fuming acid to 20 pts. water), and finally again with pure water; and the residue, amounting to 42—50 p. c. is dried (Städeler).

Properties. Colourless. Resembles cleansed silk, even when viewed under the microscope, but is easily torn, and according to Städeler, easily rubbed to a soft powder. Heavier than water.

				Städeler.	Cramer. *a.*	Cramer. *b.*	Vogel, jun.
30 C	180	48·77	47·83	48·60	48·39	48·06	49·99
5 N	70	18·97	17·36	18·89	18·40	18·21	19·03
23 H	23	6·24	6·54	6·40	6·51	6·02	6·88
12 O	96	26·02	28·27	26·11	26·70	27·71	24·10
$C^{30}N^5H^{23}O^{12}$	369	100·00	100·00	100·00	100·00	100·00	100·00

	Bolley. *a.*	Bolley. *b.*
30 C	47·08	48·50
5 N	17·70	18·89
23 H	7·20	6·58
12 O	28·02	26·03
$C^{30}N^5H^{23}O^{12}$	100·00	100·00

So according to Cramer; according to Mulder $C^{78}N^{12}H^{63}O^{22}$; according to Vogel, $C^{48}N^8H^{38}O^{17}$. — It still contained at most about 0·3 p. c. ash and traces of sulphur. Bolley's fibroïn *a* was taken from the vessels of the caterpillar and purified by boiling with water; *b* from Jama-may silk. Crooc[illegible] analysis: *Ann. Pharm.* 48, 49.

Decompositions. 1. Yields by *dry distil*[illegible] ammonia carbonate, empyreumatic oil and [illegible] charcoal. Softens when heated, burns a[illegible] and a light blue flame, and leaves a larg[illegible] 2. Dissolves only in small qu[illegible] when heated even to 170°, in large quant[illegible] has been p[illegible]

Yellow raw silk is bleached, with decomp matter, when exposed to sunshine for seven mixture of sulphurous acid gas and air or oxy colour disappears very slowly (Schönbein, *J. pr.*

The colouring matter of Jama-may silk dissol containing hydrochloric acid, with green colo green drops when the solution is concentrated, al ammonia and oxalic acid. These drops dissolve w in ether, leaving a yellow residue, more of which repeatedly evaporating the ethereal solution (Bulle

Serine.

$$C^6NH^7O^6 = C^6AdH^3O^6.$$

CRAMER. See memoir cited under Fibroïn (p. 363).

Amidoxypropionic acid, $C^6H^3(NH^2,O^2H),C^2O^2,O^2H$.

Formation. Together with leucine and tyrosine, b gelatin with sulphuric acid.

Preparation. Raw silk enclosed in a bag is evaporated and then boiled for a short time with water; to obtain str the boiling is several times repeated with fresh quantities the solution is concentrated. It is then boiled with ¼ vol. for 9 to 24 hours, the water being renewed as it evapora solution is supersaturated with lime, filtered, exactly neut dilute sulphuric acid, and evaporated. Tyrosine and gy separate out, afterwards druses of serine, and finally lem serine is dissolved in cold water, and filtered from undissolved the gypsum is removed by treatment with baryta-water and of ammonia; the liquid left to crystallise; and the crystals, w mostly reddish, are decolorised by dropping a small quantity lead acetate into the solution, and treating the filtrate with sulphuric acid.

Colourless, oblique rhombic crystals, frequently united in druses crusts. Neutral. Has a faint sweet taste.

		Crystals.			Cramer.
6 C	.....	36	.....	34·28	34·12
N	.....	14	.....	13·[illegible]	13·35
7 H	.....	7	.....	6·[illegible]	6·68
6 O	.....	48	.....	45·7[illegible]	[illegible]
$C^6NH^7O^6$	....	105	.....	100·00	[illegible]

Decompositions. Turns[illegible] en heat[illegible] burning horn. — *Nitrous* [illegible] it into [illegible] ion of nitrogen:

$C^6NH^7O^6$ +

Analyses of Sponge.

	Fremy.	Crookewit.
	p.c.	p.c.
C	49·42	49·46
N	16·12	16·12
H	6·28	6·21
O	28·18	
	100·00	

Crookewit found also 1·00 p. c. iodine, which, however, might have been derived from the potash, (Städeler) 0·50 S., 1·90 P. He gives the formula $C^{40}N^{6}H^{27}O^{7}$, and regards spongin as identical with fibroin, but combined with phosphorus, sulphur, and iodine. Schlossberger, also, who pointed out the difference between spongin and fibroin, found in thoroughly washed sponge, phosphorus, sulphur iodine, and small quantities of chlorine and bromine.

Sponge loses its elasticity at 200°, without becoming friable or suffering further alteration. When further *heated* it decomposes without softening, exhaling an offensive odour, giving off carbonate of ammonia together with a small quantity of water, and leaving charcoal, together with a quantity of ash amounting, on the average, to 3·5 p. c. (Posselt). It is not altered by several hours' boiling with water, and does not yield gelatin when thus treated (Posselt; Städeler). — When boiled with *nitric acid* of sp. gr. 1·3, it forms a colourless solution (Städeler). Moderately dilute nitric acid dissolves part of it, and leaves the rest as a yellow, soft, slippery mass, insoluble in boiling water, dissolving with strong intumescence in ammoniacal water, easily, and with fine red colour in potash (Posselt). — Dissolves in oil of vitriol when heated, forming a solution which has a faint brown colour (Städeler), is not precipitated by water (ammonia, Posselt) or potash, but gives a precipitate with infusion of galls (Crookewit). If the dark-coloured oil of vitriol be poured off before the solution is complete, the residue, after washing with water, is brittle, but not soluble in boiling water (Posselt). — When comminuted sponge previously exhausted with dilute hydrochloric acid and with soda-ley of 5 p. c., is boiled with a mixture of 1 vol. oil of vitriol and 4 vol. water, it dissolves, and after ten hours' boiling, forms leucine and glycine, but not a trace of tyrosine (Städeler). — Strong *hydrochloric acid* dissolves the sponge slowly but almost completely, without colouring it blue; the solution (colourless even when boiled, Städeler) is not precipitated by ammonia, ferrocyanide of potassium, or mercuric chloride (Posselt). — Cold dilute mineral acids and strong acetic *acid* produce no alteration.

Sponge is not altered by aqueo[illegible] Dissolves very slowly or not at all in cold dilute so[illegible] at the [illegible] (Städeler). In rather strong *pota*[illegible] more easily when wa[illegible] yello[illegible] which continues on[illegible] boili[illegible] the liquid at the s[illegible] omi[illegible] scarcely precipitab[illegible] bonic acids when t[illegible] acids sometimes fo[illegible] cipitate in the filtra[illegible]

drosulphuric acid, and neutralising with potash-ley, it still gives a precipitate with neutral lead acetate on addition of ammonia (Crocke-it).

Baryta-water dissolves sponge at the boiling heat, with transient red, and afterwards yellow colour, and on treating this solution with carbonic acid, removing the carbonate of baryta which contains a small quantity of organic substance, precipitating (*a*) with neutral acetate of lead, decomposing the precipitate with hydrosulphuric acid, and filtering, the filtrate leaves on evaporation a brown residue, the aqueous solution of which is precipitated by tincture of galls, but not by mercuric chloride or ferrocyanide of potassium. This residue is insoluble in alcohol. — *b*. When the liquid which runs off from the lead precipitate is freed by sulphuric acid from lime and baryta, it leaves on evaporation a brown deliquescent mass, to be further separated by alcohol. — *c*. The portion insoluble in alcohol yields, when digested with litharge, a lead-compound, which, after evaporation, no longer dissolves completely in water; it contains 17·50 p. c. lead oxide, after deduction of which it yields on the average, 45·8 p. c. C., 16·8 N., 6·3 H., and 33·1 O. — *d*. The portion soluble in alcohol also yields a soluble lead-salt containing 17·04 p. c. PbO., while its organic substance contains 46·2 p. c. C., 5·8 N., 6·3 H., and 41·7 O. Its solution is precipitated by tincture of galls, not by ferrocyanide of potassium or acetate of lead (Posselt).

Chlorine gas passed through the dark brown solution of sponge, obtained by digestion with potash and neutralised with hydrochloric acid, decolorises it, and separates a viscid scum, which settles down in the form of a white curdy mass; this substance contains chlorine, and has a golden-yellow colour when dry (Crockewit). — When sponge, after treatment with hydrochloric acid, but not with soda-ley, is immersed for 20 to 30 hours in aqueous *cuprate of ammonia*, it shrinks very much, and becomes easily friable, even the fibres being strongly attacked (Städeler; Schlossberger, *Krit. Zeitschr.*, 1860, 426). With soda-ley and cupric sulphate the substance of sponges behaves like fibroïn (Vogel & Reischauer). On its behaviour to red colouring matters, see Böttger (*J. pr. Chem.* 91, 246).

Conchiolin.

Frémy, *Compt. rend.* 39, 1052; *N. J. Pharm.* 27, 5; *J. pr. Chem.* 64, 257; *Pharm. Centr.* 1855, 68 and 129; in full: *N. Ann. Chim. Phys.* 43, 96; *Jahresb.* 1854, 710.

Schlossberger, *Ann. Pharm.* 98, 99; *Chem. Centr.* 1856, 487; *J. pr. Chem.* [illegible] *Jahresb.* 1856, 714. — *Krit. Zeitschr.* 1860, 424; [illegible] 670.

[illegible]rtain mussel-shells. In the horny axis of Gorgo-[illegible]ular sub[illegible] containing 49·4 p. c. C., 16·8 N., [illegible]ny). [illegible] xv. 414.

[illegible]reated with hydrochloric acid, as [illegible]soluble in water, alcohol, and [illegible]d with water, and is but very

Preparation. Hydrochlorate of hæmatin is produced by treating hæmoglobin with common salt and a large excess of glacial acetic acid; the crystals are dissolved in ammonia-water; the solution evaporated to complete dryness; and the residues heated for a considerable time to 130°, then exhausted with water and dried (Hoppe-Seyler.)—According to later statements of Hoppe-Seyler, hæmatin thus prepared has undergone partial alteration.

Lecanu drops sulphuric acid into defibrinated blood diluted with its own weight of water; suspends the resulting magma in alcohol; presses the residue; and boils it with alcohol containing sulphuric acid. The solution when quite cold is filtered, supersaturated with ammonia, again filtered and evaporated, after which the residue is washed with water, alcohol and ether, and dissolved in ammoniacal alcohol; the solution is filtered and evaporated; and the residue is washed.

Simon boils dry blood previously exhausted with boiling ether, with alcohol containing a little sulphuric acid; supersaturates the alcoholic tinctures with ammonia; leaves the sulphate of ammonia to settle; filters; distils off the greater part of the alcohol; evaporates; pulverises the residue; frees it from fat and hæmœphæin by ether, and then from admixtures soluble in water and in alcohol.

Berzelius separates the blood-corpuscles by mixing blood with strong solution of Glauber's salt; collects them; boils them with alcohol containing sulphuric acid; mixes them while still warm, with caustic ammonia or carbonate of ammonia; then filters and distils till only $\frac{1}{12}$ is left: the remaining liquid then deposits hæmatin, still requiring to be freed from fat by ether. The same process is adopted by Mulder.

v. Wittich agitates defibrinated blood with ether gradually added as long as it is taken up, and separates the lower cherry-red layer which forms after some minutes, from the supernatant coagulum by filtration. The resulting solution of hæmatoglobulin, or even fresh defibrinated blood, mixed with a very strong solution of carbonate of potash, deposits hæmatin as a dingy red clot, which is separated by filtration, dried completely at a temperature not exceeding 50°, pulverised, stirred up with absolute alcohol, and left in contact with it for a few days at a temperature below 50°. The liquid must be filtered in the cold, as otherwise globulin will remain dissolved; the alcoholic solution evaporated; the dry residue freed from fat by ether, then dissolved in water; and the hæmatin precipitated by acetic acid or by mineral acids.

Properties. Amorphous, dark greyish-blue, metallically lustrous mass, triturable to a brown powder, with brown streak (Hoppe-Seyler). Scentless and tasteless.

			Hoppe-Seyler. at 130°.	
96 C	576	61·34	60·20 to 61·18	
6 N	84	8·95	8·63	
51 H	51	5·43	5·20 to 5·41	
3 Fe	84	8	8 „ 8·83	
18 O	144	[illegible]		
$C^{96}N^{6}H^{51}Fe^{3}O^{18}$	939	10[illegible]		

a from ox-blood, *b* from sheep's [illegible] iron, mean 7·0 p.c.; Simon 7·97 p.c.

or cold; is nearly insoluble in strong hydrochloric acid and glacial acetic acid in the cold, but dissolves more abundantly when heated. Dissolves with decomposition in aqueous ammonia and caustic fixed alkalis, and the precipitate thrown down from these solutions by acids no longer yields crystals of hæmin with common salt and glacial acetic acid. Nearly insoluble in aqueous carbonate of soda, quite insoluble in alcohol and ether, but dissolves easily in alcohol which has stood over carbonate of potash (Hoppe-Seyler).

	Hoppe-Seyler. *at* 105° to 120°.				
	a.			*b.*	
C	60·82	61·14	61·02	63·36	62·15
N	8·22				
H	5·51	5·40	5·57	5·45	5·57
Fe	8·40	8·47	8·73	8·63	8·77
Cl	3·26	4·83	3·47	3·78	

b is recrystallised hæmin. Hoppe-Seyler regards all the products analysed, but especially the recrystallised hæmin, as mixtures of hæmatin free from hydrochloric acid and hydrochlorate of hæmatin. Thudichum (*J. pr. Chem.* 104, 281) doubts the existence of hydrochloric acid in the hæmin crystals.

As these crystals are obtained either from fresh or from boiled blood by treatment with glacial acetic acid, and from coagulated blood from which the salts have been washed out, after addition of common salt and glacial acetic acid, their formation may be made available for the detection of blood in forensic investigations. *Vid.* Brücke, (*Chem. Centr.* 1859, 212; *Jahresber.* 1857, 609); E. Scriba (*N. Jahrb. Pharm.* 11, 289; *Jahresber.* 1859, 707); Erdmann (*J. pr. Chem.* 85, 1); Wessel (*N. Br. Arch.* 118, 217); Blondlot (*Chem. Centr.* 1868, 750).

Hæmatin dissolves easily in water containing *ammonia*, *potash*, or *soda*, forming blood-red solutions, but does not neutralise these bases (Lecanu). Mulder's hæmatin is nearly insoluble in dilute ammonia-water, but dissolves in dilute carbonate of potash (Mulder). Ammoniacal hæmatin, evaporated over the water-bath, leaves an ammoniacal residue mostly soluble in water (Hoppe-Seyler). Hæmatin dissolved in aqueous alkalis is red in thick layers, olive-green in thinner layers (Hoppe-Seyler). Aqueous *borax* also dissolves hæmatin (Simon). Concentrated aqueous carbonate of potash precipitates hæmatin-solutions (v. Wittich). — From alkaline solution hæmatin is precipitated by acids in red-brown flocks, the liquid becoming colourless.

Ammoniacal hæmatin precipitates brown flocks from *hydrochlorate of baryta* and *hydrochlorate of lime*.

The solution of hæmatin in alkaline water, neutralised as completely as possible with acetic a[illegible] filtered, forms a flocculen[illegible] brown precipitate with the *neut[illegible] basic acetates of lead*; grey-green with *cupric acetate*; grey-b[illegible] *silver nit[illegible]* wn wit[illegible] *potassium ferrocyanide*, after addit[illegible] liquid remaining green; it colou[illegible] and throws down flocks of the sam[illegible]).

Hæmatin is precipitated from i[illegible] *acetate* as a grey-[illegible], also by [illegible] the solution in a[illegible] alcohol [illegible] brown precipitate [illegible], contain[illegible]

Salkowski (*Tübinger medic.-chem. Unters.* 1, 436) obtained from a strumous cyst, microscopic, well developed rhombic tablets, which dissolved sparingly in ether, easily and with golden-yellow colour, in chloroform. These solutions were decolorised by agitation with weak soda-ley, the colouring matter passing into the alkaline liquid. The alkaline solution gives with nitric acid a very transient blue colour, and becomes green on exposure to the air.

According to this, the body produced from decomposed blood-red exhibits the reactions of bilirubin. On the other hand, if the colouring matter of the ovary be regarded as a separate substance, namely, hæmolutein, the existence of hæmatoïdin as a distinct colouring matter becomes doubtful.

Sanson (*J. Pharm.* 21, 420) obtained from ox-blood, besides the red colouring matter, a *yellow*, a *blue*, and a *brown* colouring matter. The the first of these is probably identical with Simon's *Hæmophein* (*N. Br. Arch.* 25, 51), a body which imparts a yellow or brown colour to serum and to fat prepared from blood. The blue colouring matter, Simon (*N. Br. Arch.* 29, 139) was unable to find; according to Gmelin, it proceeded from the filter-paper used.

The *ureters of the ox* contain a body which acquires a beautiful violet colour on exposure to the air. When the ureters freed from fat are triturated with pounded glass and exhausted with alcohol, the liquid evaporated and precipitated with neutral acetate, then with basic acetate of lead, and the filtrate with cupric acetate,—cuprous oxide and hypoxanthine are thrown down, and a dingy purple liquid is obtained, which is to be freed from metals by sulphuretted hydrogen, then filtered and concentrated. The colouring matter then separates as a violet film, which dissolves with yellow colour in dilute mineral acids and in hot dilute acetic acid, and is precipitated in violet flocks by ammonia. This colouring matter is insoluble in aqueous alkalis, alcohol, ether, sulphide of carbon, chloroform, and benzene (Holm, *J. pr. Chem.* 106, 150).

e. Städeler's *Erythrosin.*—By dissolving tyrosine in nitric acid and evaporating, there is obtained—besides colourless needles of nitrate of tyrosine—a red-brown residue, the formation of which is completed by repeated stirring with water and evaporation. This colouring matter resembles hæmatin or hæmatoïdin. After washing with water and drying, it is amorphous, dark red-brown, insoluble in the ordinary solvents, easily soluble in alcohol containing sulphuric acid, and partly precipitable from this solution by ammonia. The solution then remains coloured, appearing greenish by transmitted, red and opaque by reflected light. On evaporating the ammoniacal sol[illegible] the erythrosin remains as a dark brown substance, slightly solub[illegible], insoluble in alcohol and ether, easily soluble in acidulated [illegible] aqueous alkalis. The alkaline solutions are brown-red [illegible] alis, [illegible] become green when heated in contact with the [illegible] *Pharm.* 116, 87).

immediately from the pigment of bile and another pigment of the urine.

Normal human urine behaves before the spectroscope like the pigment prepared from bile by dilute hydrochloric acid (p. 75), inasmuch as, in a layer 3 to 4 centim. thick, it exhibits an absorption-band at the limit of the green and blue. When urine is precipitated with basic acetate of lead, and the precipitate is decomposed by dilute sulphuric or oxalic acid, the reddish-yellow filtrate distinctly shows the γ-bands; solely likewise produces in this solution the same alterations as in the acid solution of bile-pigment. These appearances are exhibited with peculiar distinctness by the deep red urine of fever patients; they are not altered by dilute mineral acids, by dilute alkalis, or by keeping the urine for weeks (Jaffé, *J. pr. Chem.* 104, 404).

Heller (*Heller's Archiv.* 1846, 21; *Pharm. Centr.* 1846, 597) distinguishes uroxanthin, uroglaucin, urrhodin and uroerythrin. *Uroxanthin* which is yellow, is present in normal, and more abundantly in morbid urine; it is decomposed by acids, with formation of a saccharine substance, uroglaucin and urrhodin, and is regarded by Neubauer (*Harnanalyse.* 5 Aufl. 37, Wiesbaden, 1867) as indican. — *Uroglaucin* and *urrhodin* are, according to Heller, oxidation-products of uroxanthin. Urrhodin remains, on evaporating the ethereal solution, as a solid amorphous mass, and on slowly concentrating the alcoholic solution, in nearly black indistinct crystals; it is carmine-red in very thin layers, insoluble in water, but dissolves with fine red colour in alcohol and ether.

Urinary concretions contain moreover yellow or yellow-brown *uropheæin*, and hæmatin which produces a red-brown to black colour (Heller, *die Harnconcretionen*, Wien. 1860).

b. E. Schunck (*Proc. Roy. Soc.* 15, 1; *J. pr. Chem.* 97, 382; *Jahresber.* 1866, 750) distinguishes two normal urinary pigments or extractive matters, viz., *urian* $C^{20}NH^{12}O^{12}$, soluble in alcohol and ether, and *urianin*, $C^{20}NH^{12}O^{10}$, soluble in alcohol but not in ether. Both are very easily decomposible, and when heated in aqueous solution or subjected to the action of acids, take up water and become oxidised. Their formulæ are deduced from the analysis of the lead-compounds.

c. Thudichum (*Brit. Med. Journal*, N. S., 201, 509; *Schmidt's Jahrb.* 125, 154; *Neubauer* a. *Vogel's Harnanalyse*, 5 Aufl. 37, Wiesbaden, 1867; and further *J. pr. Chem.* 104, 257; abstr. *Chem. Centr.* 1869, 15) distinguishes a normal urinary pigment which he calls urochrome, and as decomposition-products thereof: uromelanin, uropittin and omicholic acid.

Urochrome. Urine is mixed with hydrate of baryta to alkaline reaction, for which purpose [illegible] grms. of baryta-crystals are required to 1 litre of urine—then [illegible] rated solution [illegible] te of baryta; the liquid, after standing [illegible], is filtere[illegible] filtrate is precipitated with an amm[illegible] of ne[illegible] of lead. The lead precipitate is w[illegible] compose[illegible] tion with dilute sulphuric acid; the l[illegible]; the fi[illegible] fied in the cold with carbonate of [illegible] in filt[illegible] new

iltrate is made alkaline by baryta-water and treated with carbonic cid. From the solution thus obtained, mercuric acetate throws down he colouring matter as a yellow precipitate, which is to be washed with cold and hot water, and decomposed by hydrosulphuric acid, whereupon the colouring matter immediately passes into solution, together with small quantities of hydrochloric and acetic acids. The hydrochloric acid is removed by moist oxide of silver—whereby, however, part of the urochrome is precipitated as a silver-compound, and acetate of silver is formed; the dissolved silver is removed by sulphuretted hydrogen; and the filtrate is evaporated over the water-bath (Thudichum).

Colourless amorphous yellow crusts, which partly dissolve in water, forming a yellow solution.

The aqueous solution when *kept*—more quickly in a warm atmosphere and in presence of acids—becomes darker, finally red, and deposits red flocks. No sugar is formed during this change. — Urochrome when exposed to the *air*, oxidises to a red body corresponding to uroerythrin. — When treated with *acids*, it forms three insoluble products which, by prolonged boiling of the acid solution of urochrome and mixing with water, are deposited in brown cohering lumps:— *a.* On treating these lumps with alcohol, *uromelanin* remains as a brown powder, soluble in caustic potash, precipitable by acetic acid. — *b.* The alcoholic solution has a fine red colour, is precipitable by water, and on treating the precipitate with ether, resinous *omicholic acid* is dissolved, while yellow *uropittin* remains behind. The latter separates from alcohol in crystals having the composition $C^{18}N^{2}H^{10}O^{6}$.

From aqueous urochrome, *neutral acetate of lead* throws down white flocks; the *basic acetate* yellow flocks; *mercuric nitrate* a white precipitate which becomes pale flesh-coloured on boiling, whilst the supernatant liquid turns red. *Mercuric acetate* throws down a yellow precipitate; *silver nitrate* a jelly soluble in nitric acid.

Urochrome dissolves in very dilute *mineral acids* and *alkalis*. It dissolves sparingly in *alcohol*, more freely in *ether*.

Uromelanin. — Obtained by decomposition of urochrome; also from the crude product formed from urochrome on exposure to the air. To obtain it directly from urine, the urine is mixed by drops with oil of vitriol, concentrated to one-half in a retort, and left to cool. From the precipitated resin, alcohol dissolves uropittin, while uromelanin remains behind.

Or normal human urine is left in a closed vessel for 12 months, then evaporated, whereupon it assumes a dark brown colour; the concentrated liquid is mixed with sulphuric acid, whereby uromelanin, uropittin, and omicholin are precipitated, together with a large quantity of benzoic acid; the precipitate is collected, and the benzoic acid dissolved out of it by boiling water; and the residue is freed by boiling alcohol from uropittin and omicholin, whereupon impure uromelanin remains in the form of a black powder. It is dissolved in very dilute potash-ley and filtered—which is possible only after deposition—then precipitated by dilute sulphuric acid, washed with water and with alcohol, and dried. It is pure if the preparation has been quickly conducted, but [illegible] contrary case it contains uropittin which, after [illegible] lution in [illegible] llest possible quantity of ammonia and evapora-

Preparation. 1. The younger yellow and the older red bodies are cut out with the scissors, separated as completely as possible from the tissue, rubbed to a pulp with pounded glass, and then drenched with chloroform and left for several days. The deep golden-yellow solution leaves, on spontaneous evaporation, a viscid, yellow-red fat, which gradually solidifies to a crystalline mass, from separation of fat, cholesterin, and hæmolutein. This mass is resolved by agitation with absolute alcohol into a solution and a viscid portion, which latter encloses the hæmolutein, and from which the crystals of the latter may be isolated, though with some loss, by careful washing with ether (Holm). — 2. The *corpus luteum* is dried in the air, comminuted, and exhausted with ether; the ether is evaporated, and the residue boiled for eight hours with potash-ley, by which the fat is saponified. On mixing the resulting soap with water, the hæmolutein is deposited in small, very lustrous crystals, which may be separated by filtration (Piccolo & Lieben).

Properties. Separates from the solution containing fat, in microscopic, acute-angled, triangular tablets, one side of which is convex, or replaced by two straight sides. By aggregation of two or more of these crystals, rhombic tables or more complex forms are produced. By reflected light the crystals exhibit a fine cantharides-green colour, with metallic reflex; by transmitted light, they appear red, with fine blue and violet shadings; after washing with ether, they resemble recently prepared chromic acid (Holm). According to Piccolo & Lieben, the crystals of hæmolutein are red, or in a certain aspect, blue, and lose their colour in the air, especially if likewise exposed to light. According to Thudichum, hæmolutein forms yellow microscopic crystals, appearing orange or red when of a certain thickness.

Decompositions. *Oil of vitriol* colours hæmolutein blue, and dissolves it. — *Nitric acid containing nitrous acid* imparts to it a transient light-blue colour, changing to pale-yellow; the acetic acid solution is coloured blue, and afterwards decolorised, even by dilute nitric acid; the ethereal solution mixed with alcohol, and the chloroform solution, are not coloured by nitrous acid after addition of alcohol.

Combinations. Hæmolutein is insoluble in *water*, *aqueous ammonia*, *fixed alkalis*, and *mineral acids*, also in dilute *acetic acid*, but dissolves with golden-yellow colour in warm *glacial acetic acid* (Holm). According to Piccolo & Lieben, it is decomposed by boiling glacial acetic acid. — *Acetate of mercury* (mercurous or mercuric?) throws down hæmolutein completely as a yellow precipitate; *mercurous nitrate* separates it as a yellow precipitate, becoming white on boiling or standing.

Dissolves easily in *alcohol*, acc[illegible] to Thudichum; is insoluble according to Piccolo & Lieben, an[illegible] Dissolves easily in *bisulphide of carbon* with flame-red colou[illegible] orange-red when much diluted; easily, with golden-yell[illegible] *chloroform* [illegible] not being altered by agitation [illegible] (Holm). [illegible] *ether* somewhat less abundantly [illegible] form (H[illegible] *benzene* (Piccolo & Lieben), with y[illegible]

The colouring [illegible] *egg-yolk* [illegible] others, of a red [illegible] respon[illegible] portion, correspo[illegible] -brown [illegible]

egg-oil is heated with alcohol and left to cool, the yellow separates, together with olein and cholesterin, whilst the red remains in the mother-liquor. The *red* liquid, when frequently evaporated and redissolved, becomes darker, and after prolonged heating in the water-bath, deposits black granules which leave ferruginous ash when burnt. The yellow colouring matter does not form a green solution when treated for 24 hours either with hydrochloric acid or with alcohol and sulphuric acid; with dilute potash-ley, under certain circumstances, it becomes green (Gobley, *N. J. Pharm.* 9, 170).

The colouring matter of egg-yolk is hæmolutein, or a very similar body. When the non-coagulated yolk of hens' eggs is agitated with ether, colouring matter and fat are dissolved, and remain on evaporation as a yellow mass, changing to dingy-green when stirred up with nitric acid containing nitrous acid, — also with a small quantity of oil of vitriol, whereas a larger quantity of oil of vitriol colours it dirty-brown to brown-red.

When egg-oil, after exhaustion with ether, is saponified with soda-ley of 5 p. c. — whereupon an odour of train-oil is evolved, — the soap extracted with ether, and the ether evaporated, there remains a deep gold-yellow mass, which is non-saponifiable, or saponifies only with difficulty, and on standing gradually yields crystals of cholesterin together with deep red non-crystalline particles. It assumes a transient pure blue colour when triturated with strong nitric acid; dissolves in ether and chloroform with golden-yellow, and in bisulphide of carbon with orange colour; the colouring matter is not extracted from the solution by ammonia. The solution mixed with alcohol is decolorised by nitric acid containing nitrous acid, without exhibiting any previous play of colours (Städeler, *J. pr. Chem.* 100, 148; *Chem. Centr.* 1867, 715).

The colouring matter of the shells of birds' eggs is free from iron, and is first imparted to the eggs in the cloaca, not in the oviduct. The green or bluish colour of the egg-shells of *Sylvia phœnicurus*, *Turdus musicus*, *Corvus coroni*, and *Vanellus cristatus*, exhibits, after isolation by hydrochloric acid, the reactions of biliverdin (p. 77). The brown-red egg-shells of *Falco tinnunculus* and *Buteo vulgaris*, and the red spots of the eggs of many small singing birds contain cholepyrrhin (p. 71), traces of which are also found in eggs not coloured either green or brown, but not in the pale-yellow eggs of Cochin-China fowls (W. Wicke, *Götting. Nachr.* 1858, 314; *Kopp's Jahresb.* 1859, 642).

Pyocyanin.

FORDOS. *Compt. rend.* 51, 215; *N. J. Pharm.* 38, 165; *Chem. Centr.* 1860, 772; *Kopp's Jahresb.* 1860, 597. — *Compt. rend.* 56, 1128; *Chem. Centr.* 1863, 964; *Kopp's Jahresb.* 1863, 657.
[illegible] *Arch. f. klin. Chirurgie* 3, 135; *Chem. Centr.* 1863, 966; [illegible]b. 1863, 658.

[illegible] asic[illegible] us from wounds, which then colours the [illegible] Lücke, its formation is connected with [illegible] also Chalvet (*N. J. Pharm.* 38, 377). — [illegible] pus had already been observed by [illegible] (*N. Br. Arch.* 81, 159), and Dehors (*Compt.*

17·61 oxygen. In other cases the black lung-pigment has been found to consist of carbon, or even of sulphide of iron (Perls, *J. pr. Chem.* [1], 90).

The black colouring matter found in the liver of patients suffering from melanotic cancer, consists of uromelanin (p. 411) (Thudichum). When the black nodules separated from the liver are left under water for a year, the putrefaction which ensues destroys the foreign substances, but not the uromelanin. (The further treatment as described in the *Chem. Centr.*, is unintelligible, K.). — Hard, amorphous, dark brown powder, without taste or smell. When heated it smoulders slowly, and without fusion, and burns away with an odour of horn. Dissolves easily in fuming nitric acid, forming a deep red liquid. Strong hydrochloric acid acts in a similar manner, whereas oil of vitriol scarcely acts upon it. Chlorine decolorises the melanin quickly in alkaline solution, slowly when suspended in acids. By fusion with potash, volatile fatty acids are produced.

Melanin swells up in water like albumin, and colours warm water brown. Dissolves in the aqueous hydrates, monocarbonates, and bicarbonates of the alkalis, also in aqueous urea, with evolution of ammonia if heat is applied. The alkaline solutions are precipitated by acids and salts; the solution in potash-ley becomes decolorised after standing for a year, and then yields a white precipitate with acids. Dissolves in boiling alcohol, with brown colour, not in alcohol containing sulphuric acid; insoluble also in chloroform and bisulphide of carbon.

After deduction of 1·47 p. c. ash, it contains on the average 51·73 p. c. carbon, 5·07 hydrogen, 13·24 nitrogen, and 29·96 oxygen, agreeing with the formula $C^{18}N^{2}H^{20}O^{8}$ (Dressler, *Prager Vierteljahrsschr. f. prakt. Heilkunde*, 88, 9; *Chem. Centr* 1866, 395).

According to Pribram (*Prag. Vierteljahrsschr. loc. cit.*; *Chem. Centr.* 1866, 397) a black pigment from the urine of a patient suffering from melanotic cancer of the eye, belongs to this place.

Sepia Black. — Examined by L. Gmelin (*Schw.* 10, 533); by Prout (*Thoms. Ann.* 5, 419) after exhaustion with water and hydrochloric acid.

Prout found sepia-ink to be infusible and difficult to burn; the ash contained a large quantity of ferric oxide. It was insoluble in warm hydrochloric and sulphuric acid; dissolved in nitric acid with red brown colour and evolution of nitrous gas; partly in warm aqueous ammonia, and in boiling potash-ley, forming a dark brown solution, from which it was partially precipitated by hydrochloric or sulphuric acid, not by nitric acid. — Gmelin found a small quantity of iron in the ash; the ink dissolved in oil of vitriol, and was precipitated by water.

Bizio (*Schw.* 45, 128) described as *Melain* [illegible] of sepia, apparently altered by nitric acid, which he obtai[illegible] with water, boiling the portion which remain[illegible] and alcohol, then with dilute nitric acid (whe[illegible] nitric oxide were evolved), and washing out [illegible] aqueous carbonate of potash and with water. [illegible] which detonates when heated; is not decolorised [illegible] posed by strong nitric ac[illegible] when heated w[illegible] verted, with evolution [illegible] acid, into [illegible] which water separates [illegible] melain. It d[illegible] boiling water, forming a [illegible], from whi[illegible]

a concentrated solution of aniline-red and aniline-voilet. It decomposes very easily in the dissolved state; if it be precipitated by sulphuric acid, and again from alcoholic solution by common salt, a substance is obtained which exhibits the reactions of aniline-violet. The colouring matter which remains dissolved after the precipitation by common salt may be separated by tannic acid, and like fuchsine, is decolorised by ammonia, and coloured red again by acetic acid (Ziegler, *Mult. Soc. Bull.* 37, 295; *Kopp's Jahresber.* 1867, 821).

On the purple pigment which sometimes makes its appearance on mouldy articles of food (bread, potatoes, meat), see Sette (*Schw.* 50, 415); Meylink (*Repert.* 43, 13), Buchner (*Repert.* 43, 88); Pelouze (*J. Chim. med.* 19, 586; *N. Ann. Chim. Phys.* 9, 5); Ehrenberg (*J. Chim. méd.* Oct. 1848); Oberdörffer (*N. Br. Arch.* 49, 43); Hübner (*N. Br. Arch.* 50, 302). According to Erdmann (*J. pr. Chem.* 99, 385; *Jahresb.* 1866, 670), this colouring matter exhibits the reactions of the aniline dyes, the red that of the salts of rosaniline, and a blue sometimes observed at the same time, that of the salts of triphenylrosaniline.

On the green colouring of oysters, see Valenciennes (*J. Pharm.* 27, 155); on the colouring matters of sweat: Schottin (*Pharm. Viertelj.* 2, 54); Landerer (*Repert.* 55, 234; *Handbuch*, viii, 302).

Proteides of the Vegetable Kingdom.

The nitrogenous and sulphuretted substances occurring in the vegetable kingdom, and formerly designated as *vegeto-animal substance*, have more recently been further distinguished according to the following considerations.

a. When the dough of wheat-flour is kneaded with water as long as the water becomes milky from separation of starch, there remains a grey elastic glutinous mass, the *gluten* of Beccaria (*Common. Bonon.* 1, 1, 122).

b. The expressed juice of many plants coagulates when heated, by separation of a similar substance (Rouelle, *Crell. Beiträge zu den chem. Ann.* 1, 3, 87); the substance thus separated resembles animal albumin: *Vegetable albumin* (Fourcroy, *Ann. Chim.* 3, 252), and gluten (Proust, *J. Phys.* 54, 199; *A. Gehl*, 5, 596).

c. Rye-flour yields coagulated *vegetable albumin* and *gluten* soluble in alcohol. When the flour is separated by stirring it up with cold water and leaving it to settle into sedimentary flour and a solution, the latter deposits the albumin on boili[illegible] and from the filtrate concentrated to the consistence of hone[illegible] [illegible]luten may be extracted by alcohol. — The same gluten is obta[illegible] the sedimentary flour is separated by levigation into sta[illegible] [illegible]rey substance and the latter is exhausted with alcohol ([illegible] [illegible]*l.* 5, 13[illegible] [illegible]berg (*J. pr. Chem.* 85, 214).

d. The wheat-gluten of Becca[illegible] with alcohol, into residual *zymome* a[illegible]

obtained by evaporating the [illegible] Taddei, *Schw.* 29, 514).

According to this, the [illegible] r *d*) is to be distinguished [illegible]

e. Vegetable gelatin [illegible] *stance*, which is obtained [illegible] acid, mixing with [illegible] form of a transparent [illegible] ng to Berzelius, this [illegible] which is obtained by [illegible] iltered decoction with an [illegible] iltering from *glute*[illegible] and evaporating the [illegible]

f. Leguminous [illegible] different from vegetable [illegible] emains suspended in the water [illegible] s deposited on further [illegible] nitrogenous and sulphureted [illegible] from the aqueous extract [illegible] with nitric acid, but [illegible] Braconnot (*Ann. Chim. Phys.* [illegible]

g. Relying upon the [illegible] proteides and the [illegible] his memoir "On the Nitrogen [illegible] *Ann. Pharm.* 33, 12[illegible] distinguishes:

1. As *Vegetable A*[illegible] ion in aqueous plant-[illegible] acetic acid, but coagulates when heated.

2. As *Plant-fibrin*, the constituent of the [illegible] insoluble in water and [illegible] fruits.

The plant-albumin and plant-fibrin [illegible] together, the plant-albumin [illegible]

3. As *Plant-casein* the constituent of leguminous [illegible] solves in the cold aqueous extract [illegible] extract, but is precipitable by acetic acid; the precipitate [illegible] aqueous ammonia.

The legumin of Braconnot belongs, therefore, to Liebig's plant-casein. But Liebig further designates as plant-casein the constituent of the infusion of almonds which is precipitable by acetic acid, as plant-albumin, and the constituent of the same extract [illegible]

4. *Plant-gelatin* does not, according to Liebig, exist [illegible] or only to a small amount, in the flour of cereals and leguminous [illegible] It is a casein-compound containing acid; its solution in aqueous ammonia, heated to the boiling point, deposits a small coagulum when [illegible]ic acid is dropped into it.

Dumas & Cahours (*N. Ann. Chim. Phys.* 6, 385) use the [illegible] *umin* and [illegible] *rin* almost in the same sense as Liebig, [illegible] that th[illegible] he former chiefly to the coagulum which [illegible] from g[illegible] when heated; the latter to that portion of

the gluten which is insoluble in boiling alcohol. T
different from that of Liebig, is the portion of the al
gluten which separates on cooling, therefore perhaps
gluten of Ranssure; their *plant-gelatin* is the substance
only on further concentration and cooling, therefore
Ranssure.

The name *leguminin* is applied by Dumas & Cahours to
of leguminous fruits and oleaginous seeds which is
acetic acid, therefore Liebig's vegetable casein, as well
stituent of oleaginous seeds which is coagulable by heat
belongs, according to Liebig, to vegetable albumin.

i. Günsberg distinguishes in wheat-gluten: 1. A c
soluble either in alcohol or in boiling water: the *fibrin* of
portion soluble in alcohol, insoluble in boiling water: *gl*
gliadin; 2. A portion soluble in alcohol and in boiling wa
gelatin. When crude gluten is kneaded with cold alcohol
long as the extract is rendered turbid by water, and the
boiled, first with weak and then with strong alcohol, the fib
The united extracts filtered, distilled, and further concentrat
on cooling a mixture of casein and gelatin, which may be
foreign constituents by cold water, and resolved by boiling w
into gluten-gelatin, which dissolves, and casein, which re
hind. The gluten-casein is obtained by evaporating the d
(Günsberg).

k. v. Bibra (*Die Getreidearten und das Brod*, Nürnberg 18
and Ritthausen (*J. pr. Chem.* 85, 193; 86, 257)—the latter, so
he used boiling alcohol to decompose the wheat-gluten—likewi
tinguish the insoluble portion as *plant-fibrin*, the constituents
pass into solution as *plant-casein* or *paracasein*, which separates
first instance, and *plant-gelatin*, which does not separate even on
centration. Afterwards Ritthausen (*J. pr. Chem.* 91, 296) obs
that this process gives rise to a transformation of soluble into
soluble constituents of the wheat-gluten; he therefore dissolved
gluten in water containing potash, precipitated with acetic acid, a
decomposed the precipitate by treatment with cold alcohol. The su
stances thus obtained are designated as follows:

1. *Paracasein, Gluten-casein*: the portion insoluble in alcohol.

2. *Plant-fibrin, Gluten-fibrin*: the portion which first separates from
the alcoholic solution.

3. *Mucin, Mucedin*: a portion precipitable from the mother-liquor
by absolute alcohol.

4. *Plant-gelatin, Gliadin*: the portion which remains in solution.

The *leguminin* of leguminous-fruits, or pulse, approaches very nearly
to gluten-casein; almonds and lupines contain *conglutin*, a substance
different from legumin, [illegible] maize, and oats contain substances
agreeing almost exac[illegible] constitue[illegible] with gluten-
casein and mucedin; t[illegible] stituent of [illegible] gluten-fibrin;
a subordinate constitu[illegible] lutin; [illegible] with legumin
(Ritthausen).

l. Commaille disting[illegible]
cold water, na[illegible] L[illegible]

[illegible]

[illegible]

[illegible]

[illegible] by Liebig, Jone[illegible] the cold aqueous [illegible] with aceti[illegible]

lant-juices have a neutral or acid reaction, not alkaline like solutions animal albumin (Dumas & Cahours).

	Boussingault. *Wheat.*	Liebig. *Wheat.*	Jones. *Rye.*	*Almonds.*	Dumas & Cahours. *at* 140°. *Wheat.*	Rüling. *at* 100°. *Peas.*	Rüling. *at* 140°. *Potatoes.*
C	52·49	53·97	53·71	55·96	53·74	52·45	53·81
N	18·40	15·92	15·85	13·75	15·65		
H	6·90	7·23	7·77	7·53	7·11	6·81	7·32
O	22·21	22·88	22·67	22·76	23·50		
	100·00	100·00	100·00	100·00	100·00		

After deduction of 1 p.c. ash (Boussingault), of 8·5 p.c. (Dumas & Cahours), of 89 and 1·40 p.c. (Rüling). The albumin of peas contains 0·80, that of potatoes 98 p.c. sulphur (Rüling); that of peas contains 0·80, that of wheat 1·04, that of re 0·77 p.c. sulphur (Mulder, *Scheik. Onderzoek*, 4, 404; *J. pr. Chem.* 44, 503).

The albumin of plant-juices coagulates at 50°—60° (Proust), that of rheat at 80° (Boussingault). — The tubers of *Dioscorea Batatas* contain a peculiar vegetable albumin which coagulates only after prolonged oiling (Frémy, *Compt. rend.* 40, 128).

When kept in the moist state, it passes into stinking *putrefaction*, ccompanied by evolution of gas, and formation of leucine, together with he same volatile products that are evolved from cheese (Liebig). — Coagulated plant-albumin dissolves in *oil of vitriol* with red-brown olour; in fuming *nitric acid*, with formation of oxalic acid (Link). It lissolves in warm concentrated *hydrochloric acid* with black to violet lue colour (Liebig). The albumin of cabbage forms with *chromic acid* dark yellow curd (Hünefeld, *J. pr. Chem.* 9, 30).

The albumin dissolved in plant-juices is precipitated by *acids*, *salts*, nd *alcohol* (Proust). It is not precipitable by *acetic acid* (Liebig). Albumin prepared from potatoes with water containing sulphuric acid, loes not coagulate when its ammoniacal solution is boiled, but acetate f ammonia precipitates the solution even in the cold, and more bundantly when heated, so that the filtrate is no longer clouded by cetic acid (Löwenberg).

Plant-albumin dissolved in ammonia is precipitated by *oxalate of ammonia* even in the cold, the filtrate being precipitable by acetic acid; by *nitrate of ammonia* only at the boiling heat; by sulphate of ammonia, sulphate of soda, and chloride of sodium, completely in the cold (Löwenberg, *Pogg.* 78, 327).

The albumin of potatoes dissolves in *potash-ley* and is precipitated [illegible]refrom by acids. When boiled with alcoholic potash, it gives off [illegible] to 2 p.c. of its weight of ammonia (R. Theile, *Chem. Centr.* 1867, [illegible]). — Gluten-albumin separated by heating dissolves partially while [illegible], in moderately diluted aqueous *saltpetre*, the solution being [illegible]d turbid by hydrochloric acid. It does not harden with mer-[illegible]ride

phate and then with potash-ley, a clear reddish-violet liquid is formed if the legumin is pure; whereas legumin containing starch or gum, forms a [illegible] sometimes turbid liquid.

2. Shelled peas are washed with warm water as long as the liquid is thereby coloured, then triturated with ammoniacal water; the liquid is precipitated with acetic acid; and the precipitate is washed, out of contact of air, with water, alcohol, and ether. Legumin thus prepared still contains foreign substances, which may be removed by dissolution in strong potash-ley, precipitation of the filtrate with acetic acid, washing, redissolution in aqueous ammonia, and precipitation with acetic acid (Rochleder).

3. Löwenberg dissolves the legumin precipitated by acetic acid from infusion of peas, and washed till the wash-water exhibits an alkaline reaction, in aqueous ammonia; strains; warms the liquid till the excess of ammonia is expelled; mixes it with common salt, and boils, whereby albumin is precipitated. From the filtrate acetic acid precipitates the legumin, which must be thoroughly washed with cold water and treated with boiling alcohol and ether. By this treatment albumin, and a body soluble in water but insoluble in acetic acid, are removed (Löwenberg).

Braconnot triturates macerated peas with cold water; leaves them to settle; and evaporates the liquid, whereupon the legumin separates in greenish mucous films, which are purified by washing with water and boiling with alcohol. Or he precipitates the aqueous extract with nitric acid; exhausts the precipitate with boiling alcohol; dissolves it in boiling water with the aid of a little ammonia; boils till the greater part of the ammonia is volatilised; and precipitates with alcohol. — Liebig and Jones precipitate with sulphuric acid, and exhaust the precipitate with ether after washing it with water. Dumas & Cahours precipitate with very dilute acetic acid, not in excess; wash the precipitate with water, alcohol, and ether, and dry it in a vacuum at 140°. — Theile precipitates the extract of peas, clarified by deposition, with alcohol. Noad and Norton purify it by solution in ammonia and precipitation with acetic acid.

Properties. Amorphous, white, loose, friable mass (Ritthausen); that prepared by other methods is often coloured. Legumin precipitated from concentrated solutions by acids, has a moist pearly lustre; dilute solutions yield it in flocks (Dumas & Cahours). It has always an acid reaction, probably due to the presence of phosphoric acid (Einhof; Ritthausen). Braconnot's legumin is neutral or alkaline.

Legumin from Peas.

	Dumas & Cahours. at 140°.	Rochleder. 130°.	Rüling. 100°.	Noad. 100°.	Norton. at 130°.	
C	50·53	54·05	50·59	50·78	50·72	50·57
H	18·15	14·78	16·54	15·94	15·77	16·84
N	6·91	7·40	6·83	7·88	6·56	6·90
O			0·47		0·77	0·33
S			25·57			
P	1·90		0·60		0·77	1·23
					2·31P	1·66P

The aqueous extract of pulse leaves, when ignited, an alkaline ash containing potash and phosphoric acid. It is not precipitated by lime-salts or sulphate of magnesia in the cold, but gives a precipitate with these reagents when gently heated. Under all these circumstances vegetable casein reacts in the same manner as animal casein (Liebig).

Legumin dissolves in cold *oil of vitriol;* the viscid solution when heated in the water-bath, becomes mobile, dark purple-coloured, and no longer precipitable by water. By prolonged boiling of legumin (from hog-beans) with moderately dilute sulphuric acid, there are formed: leucine, and a small quantity of ammonia (Braconnot); also tyrosine, glutamic acid, active aspartic acid (Ritthausen's former legamic acid), and amorphous brown substances (Ritthausen). The solution in *nitric acid* leaves on evaporation, oxalic acid and a yellow body having a harsh and bitter taste (Braconnot). — Dissolves completely in fuming *hydrochloric acid*, after boiling for 15 to 20 minutes, forming a brown liquid not precipitable by excess of ammonia (Ritthausen).

Iodine appears to render legumin soluble in water; on heating the solution, a yellow iodated precipitate is formed, which, when washed with boiling alcohol and dried, turns starch blue and gives off iodine when heated. It is insoluble in boiling water, but dissolves easily and without coloration in aqueous ammonia, and is precipitated by nitric acid (Braconnot).

Heated with *bichromate of potash* and *sulphuric acid*, legumin yields prussic acid, bitter almond oil, and benzoic, formic, and other volatile fatty acids: also acetonitrile and valeronitrile (Fröhde, *J. pr. Chem.* 77, 290).

Dissolves easily in dilute *ammonia-water*. On exactly neutralising the solution with acetic acid and boiling, the liquid coagulates, and does not retain in solution any substance precipitable by acetic acid. If the ammoniacal solution be left to evaporate at a low temperature, the whole of the protein-substance separates as a scum (Löwenberg).

Legumin dissolves very easily in dilute *potash* or *soda-ley*. Water containing one or two thousandths of potash-hydrate, dissolves pulverised legumin completely in a day or two, without turbidity or decomposition (Ritthausen). By repeated solution in (stronger) potash-ley and precipitation with acetic acid, sulphuretted hydrogen is each time evolved (Rüling). The solution in potash-ley, exposed to the air for 8 to 10 days, gives off ammonia and deposits white flocks; after this it does not evolve ammonia on boiling, till it has been concentrated so far as to solidify on cooling. If it be continually boiled and the water renewed, brown flocks are separated, and a brown solution is formed, from which acetic acid separates grey flocks (Rochleder). When the boiling is continued for eleven hours, at intervals of a week, about 3 p. c. of the legumin goes off as ammonia (Theile, *Jenaer Zeitschr.* 4, 264; *Chem. Centr.* 1868, 691).

Dissolves in aqueous *carbonates* and *phosphates of the alkalis*, forming a turbid liquid (Ritthausen).

Legumin precipitated by [illegible] acid and dissolved in [illegible] precipitated by *oxalate*, [illegible] *phate of ammoni*[illegible] but on boiling; by *chloride* [illegible] *lphate of so*[illegible] boiling heat (Löwenberg).

Dissolves in cold, ver[illegible] *baryta* [illegible] gummy, frothing liquid, wh[illegible] boiling [illegible] slightly precipitated by acid [illegible] precip[illegible]

acids (even by carbonic acid, Einhof), and by vegetable acids not in excess; also by alcohol. — Legumin precipitated by sulphuric acid, and suspended in water so as to form a milk, produces a thick curd when boiled with *carbonate of lime, baryta*, or *magnesia*. Legumin suspended in water, coagulates when boiled with *gypsum-water* (Braconnot).

On agitating an alkaline solution of legumin with a small quantity of *cupric sulphate* and potash, a clear violet or reddish-violet solution is formed; with impure legumin, however, it is blue and turbid (Ritthausen). *Mercuric chloride* and many other metallic salts coagulate legumin suspended in water (Braconnot). Mercuric chloride produces a precipitate insoluble in hydrochloric acid (Commaille). — *Bichloride of platinum* throws down from an alkaline solution of legumin, a precipitate containing 5 p. c. platinum; from legumin prepared with hydrochloric acid, a platinum-salt is obtained, containing 9·8 to 10 p. c. platinum (Commaille).

Moderately dilute *acetic acid* dissolves legumin (Einhoff; Ritthausen); according to Liebig and Rochleder, it does not. The precipitate thrown down by acetic acid from legumin-solutions dissolves in excess of the acid (Löwenberg).

Legumin dissolves easily in aqueous *oxalic, tartaric*, and *citric* acid. The dilute solutions have a scarcely perceptible sour taste; they are precipitated by mineral acids, also by nitrate of baryta, nitrate of lime, nitrate of lead, ferrous sulphate, cupric sulphate, and tincture of galls; not by acetate of baryta, alumina or lead, by mercuric chloride, or by alcohol (Braconnot).

Insoluble in *alcohol* (Braconnot) (comp. p. 423), *ether*, and *volatile oils*. *Tincture of galls* does not precipitate solutions of legumin (Braconnot).

Appendix to Legumin.

1. Almond-legumin.

Proust. *J. Phys.* 54, 199; *A. Gehl.* 5, 596. — Buchholz, *A. Gehl.* 6, 617. — A. Vogel, *Schw.* 20, 64. — Boullay. *Ann. Chim. Phys.* 6, 40. — Pfaff. *Materia Medica*, 6, 136. — Soubeiran, *J. Pharm.* 12, 52. — Payen & O. Henry. *J. Chim. méd.* 2, 156.
Dumas & Cahours. *N. Ann. Chim. Phys.* 6, 423.
Mulder. *Scheik. Onderz.* 4, 404; *J. pr. Chem.* 44, 503.
Norton. *Sill. Am. J.*, [2], 5, 22; *Pharm. Centr.* 1848, 241; *Lieb. Kopp's Jahresb.* 1847—1848, 843.
Bull. *Ann. Pharm.* 69, 145; *Pharm. Centr.* 1849, 353; *Lieb. Kopp's Jahresb.* 1849, 495.
Ritthausen. *J. pr. Chem.* 103, 78, 193, and 273; *Zeitschr. f. Chem.* [2], 6, 126.

eds of many plants belonging to other families, when treated ous fruits for the preparation of legumin, yield substances llied to legumin, but exhibiting certain diversities in their d perhaps also in their reactions.

d belongs the of the oleaginous, emulsion- e *Emulsin* of edition of this handbook, the öbereiner, nas & Cahours regard as

a. From sweet almonds, the kernels of plums, apricots, hazel-nuts, and white mustard, one and the same proteide is obtained, identical in properties and composition with the legumin of pulse. According to Liebig (p. 423) oleaginous seeds contain plant-albumin and plant-casein; according to Löwenberg, sweet almonds, like peas, contain three different proteides (p. 423).

b. The legumin of sweet and bitter almonds is richer in nitrogen than that of pulse, and exhibits, even to the amount of sulphur, the composition of legumin from yellow lupines (Ritthausen).

Ritthausen designates the legumin of almonds and of lupines as *conglutin.* According to his earlier statements, this proteide is to be distinguished from legumin, because, when boiled with dilute sulphuric acid, it yields, besides aspartic acid and the other products of legumin, 5 to 6 p.c. of glutamic acid. This reaction, however, has not been established, either for the conglutin of almonds, or for that of maize (*infra*), but only for that of yellow lupines; moreover Ritthausen has more recently obtained both these acids from the legumin of hog-beans.

	Dumas & Cahours.			Ritthausen. *At* 130°.				
	at 140°.	Norton.	Bull.	*a.*	*b.*	*c.*	*d.*	*e.*
C	50·90	50·74	51·02	50·24	50·63	50·83	50·66	51·81
N	18·93	17·24	15·80	18·37	17·97	18·40	16·65	17·73
H	6·72	6·60	6·87	6·81	6·88	6·92	7·02	7·19
S		0·30	0·57	0·45	0·40	0·91	0·45	
O			25·74	24·13	24·12	23·24	25·21	
Ash		0·26	1·59	2·66	1·23	1·45	1·71	
PO^5, *a.*		0·81		2·38	0·31	0·48	1·53	
PO^5, *b.*					0·89	0·96		

From sweet almonds (Norton, Bull, Dumas, & Cahours). The latter examined also, with nearly the same results, legumin from palm-kernels, apricot-kernels, hazel-nuts, and white mustard. A second sample of legumin contained 16·75 p.c. N. (Bull). — *a*, From sweet; *b*, from bitter almonds; *c*, from yellow; *d*, from blue lupines; in the last cases the purification was perhaps not quite perfect; *e*, from maize-flour, which had been freed from maize-fibrin by warm alcohol, then exhausted with water containing potash, and precipitated with acetic acid (Ritthausen, *J. pr. Chem.* 106, 488).

See also the remarks on the analyses of legumin (p. 430).

Conglutin in the moist state is more glutinous, and more soluble in acetic acid then legumin, but exhibits the same reactions, especially towards water, very dilute aqueous ammonia, potash, and soda, and concentrated hydrochloric acid (Ritthausen).

Almond-legumin is precipitated, according to Norton, from the ammoniacal solution by neutral acetate of lead, whereas the ammoniacal solution of pea-legumin is merely clouded by that salt.

When conglutin from lupines is boiled for ten or twelve hours with 3 pts. oil of vitriol and 6 pts. water in a flask with reversed condenser, and the solution freed from sulphuric acid is concentrated, tyrosine, leucine, and glutamic acid crystallise out from it successively as it cools. The mother-liquor, which is still strongly acid, deposits, when neutralised with carbonate of baryta and mixed with alcohol, glutamate of baryta mixed with aspartate; and the filtrate when freed from

lcohol by distillation and [illegible] resembling eucine, from which by boiling [illegible] mass with absolute [illegible] of pine-conglutin may be [illegible] containing 5·21 p. c. C., [illegible] residue, insoluble in absolute [illegible] 34; 106, 445; [illegible]

Almond-legumin. [illegible] altered almond milk [illegible] and reprecipitating [illegible] *latinum* a precipitate containing [illegible] chloric solution is precipitable [illegible] [4], 4, 108; *Jahresb.* [illegible]

Other statements respecting differences between almond-legumin and the legumin of [illegible] arising from the fact that statements [illegible] of the aqueous extracts of peas and almonds [illegible] regarded as applicable to the [illegible]

When concentrated seed-milk [illegible] ether, and the lower watery layer [illegible] ng point, coagulated plant-albumin [illegible] precipitable by acetic acid [illegible] acetic acid added to the [illegible] oil, throws down plant-casein, whilst plant-albumin remains dissolved (Liebig).

Similar observations had previously been made by Payen, [illegible] and Gmelin.

To this head also belong the statements of [illegible] the reactions of legumin, all of which refer to the substance precipitated by acetic acid from infusion of [illegible]

This almond-legumin is separated as a [illegible] aqueous extract, as a pearly-[illegible] acetic acid, and in flocks by dilution. [illegible] mineral acids likewise precipitate [illegible] Strong nitric acid dissolves dry almond-legumin [illegible] vapours; [illegible] without formation of [illegible] with fine [illegible] heated, with evolution of ammonia [illegible] in boiling baryta and lime-water [illegible] to a transparent jelly and [illegible] solution leaving on evaporation [illegible] the same composition as almond-legumin.

Almond-legumin does not [illegible] in weak boiling [illegible] sion of almonds [illegible] deposits coagulated almond-legumin [illegible] soluble in acetic acid [illegible] 50·41 p. c. [illegible]

2. Avenin, or Oat-legumin.

NORTON. *Sill. Am. J.* [2], 5, 22; *Lieb. Kopp Jahresb.* 1847-48, 844.
KREUSLER. *J. pr. Chem.* 107, 17; *Chem. Centr.* 1869, 609.

First distinguished by Johnston. — Occurs in oats, together with vegetable gelatin.

Preparation. 750 grms. of finely bruised oats are drenched with a mixture of 5 litres of water and 3 grms. of potash-hydrate; the liquid is left to itself for 12 hours in the cold, and then strained; the residue is washed with water and left to settle, and the turbid brown liquid drawn off from the deposit of starch is precipitated with dilute acetic acid. The greyish-white precipitate, after it has settled down, is collected, washed on a filter with alcohol of 80 p. c., whereby it is rendered compact and separable from the filter, then exhausted with strong alcohol, and finally with ether. For dehydration it is freed as much as possible from ether by pressure, then drenched with absolute alcohol, and left at rest for 12 to 24 hours, after which it is dried over oil of vitriol, and finally in the water-bath. Avenin thus prepared still retains starch, which may be removed by dissolving the avenin in water containing $\frac{1}{10}$ p. c. potash-hydrate, and precipitating the clarified solution with acetic acid. Oatmeal previously exhausted with cold or hot alcohol may be used in the preparation instead of fresh oatmeal.

Avenin prepared as above, especially that which is obtained from fresh oatmeal, still retains vegetable gelatin, which lowers its amount of nitrogen by nearly ½ p. c., and increases the carbon in the same proportion. It may be purified by repeated boiling with alcohol of 60 p. c., but then almost entirely loses its solubility in dilute potash and acetic acid (Kreusler).

Properties. Loose, easily friable mass, having an earthy aspect, and white colour inclining to grey; in other respects it exactly resembles legumin prepared in a similar manner (Kreusler).

	Norton. *a.*	Norton. *b.*	Kreusler. *mean, at* 140°.
C	52·36	51·82	51·63
N	14·76	16·39	17·16
H	6·85	6·86	7·49
S	1·06	1·11	0·79
O	24·16	22·82	22·93
	99·19	99·00	100·00

Norton's avenin (*a*) was precipitated from aqueous extract of oats by acetic acid, and purified by solution in ammonia, precipitation with acetic acid, and exhaustion with alcohol and ether; *b* was extracted by ammoniacal water from oats previously exhausted with water, precipitated and purified in a similar manner. It still retained 0·75 and 0·86 p. c. ash, 0·81 and 1·00 phosphorus (Norton). Kreusler's avenin contained 1·56 p. c. ash, and 1·36 PO^5, both of which are deducted.

Avenin exactly resembles legumin in its behaviour to precipitants; it does not dissolve in *water*, either cold o

swells up strongly in the latter; on the other hand it dissolves slowly in strong *hydrochloric acid*, the solution gradually turning reddish-blue; in *oil of vitriol* diluted with an equal volume of water, the solution becoming dark red-brown on boiling. It is nearly insoluble in aqueous *oxalic acid*, dissolves easily in warm aqueous *tartaric acid*, and when freshly precipitated, easily also in *acetic acid*, and is precipitated in its original state on neutralising the solution with an alkali. — It dissolves slowly but abundantly in water containing $\frac{1}{10}$ p. c. *potash-hydrate;* the solution is brown, yields a greyish-white flocculent precipitate with acetic acid, and, if previously boiled, gives off at the same time the odour of sulphuretted hydrogen. Avenin boiled with water is insoluble in acetic acid and in potash, but swells up to a jelly in acetic acid. *Alkaline phosphates* likewise dissolve avenin; *ferrocyanide of potassium* precipitates it from the acetic, not from the alkaline solution (Kreusler).

3. Glutamic acid, $C^{10}NH^9O^8$.

RITTHAUSEN. *J. pr. Chem.* 99, 6, and 454; 107, 218.

Formation. By boiling plant-fibrin, mucedin (from wheat or rye), legumin, conglutin, or gluten-casein with dilute sulphuric acid; mucedin thus treated yields about 30 p. c. of glutamic acid.

Preparation. 1. Two pts. of plant-fibrin or mucedin are boiled with 5 pts. oil of vitriol and 13 pts. water for 24 hours, renewing the water as it evaporates, whereby there is obtained from plant-fibrin a black, from mucedin a slightly coloured liquid. This liquid is supersaturated with milk of lime, filtered, and concentrated; the dissolved lime is removed by oxalic acid, the sulphuric acid by carbonate of lead; and the solution is freed from lead by sulphuretted hydrogen, and concentrated. It then yields, if plant-fibrin has been used, a crystalline mixture of tyrosine, leucine, and glutamic acid, which may be separated by recrystallisation and treatment with warm alcohol of 30 p. c., the leucine then dissolving, while the glutamic acid remains behind.

2. Legumin or conglutin is boiled with dilute sulphuric acid, whereby knobby crystalline masses are obtained, consisting of glutamic acid mixed with optically active aspartic acid. On repeatedly boiling these masses with spirit of 50—60° p. c., the greater part of the aspartic acid remains undissolved, and an additional quantity of that acid separates from the hot alcoholic solution, while the glutamic acid remains in the mother-liquors, and may be obtained in crystals by distillation and concentration over oil of vitriol.

Properties. Shining, transp[illegible] crystals, which, according to Werther, are dist[illegible]hedrons. Melts at about 140°, with some loss of [illegible]decomposition. Has an acid taste and reaction. [illegible] the line D, $[\alpha] = 34{\cdot}7°$.

	Crystals.		Ritthausen. mean.
10 C	60	40·81	41·1
N	14	9·52	9·4
9 H	9	6·12	6·3
8 O	64	43·55	43·2
$C^{10}NH^9O^8$	147	100·00	100·0

Decomposes when heated, emitting the odour of burnt horn, giving off an alkaline oil, and becoming carbonised. With *nitrous acid* the aqueous acid gives off nitrogen, and forms *glutaric acid*, $C^{10}H^8O^{10}$, an amorphous optically inactive acid, whose lead-salt, $C^{10}H^6Pb^2O^{10}$ + aq., contains 43·97 p. c. C., 4·47 H., and 51·56 O.

Glutamic acid dissolves in 100 pts. of water at 16°. It decomposes carbonates, with evolution of carbonic acid. It is bibasic. The *potash salt* crystallises with difficulty from alcohol in tufts of needles. The glutamates of the *alkaline earths* are amorphous, and very soluble in water and alcohol. — The *acid baryta salt* contains at 100°, 31·4 p.c. barium, agreeing with the formula $C^{10}NH^8BaO^8$ (calc. 31·9 p. c.).

The *neutral copper salt* obtained by boiling the acid with cupric hydrate, separates from aqueous solution in well defined deep-blue crystals, very much like those of aspartic acid; after drying in the air, they give off 29·70 p. c. water at 140° (calc. for 5HO = 30·42 p. c.).

	Dried at 140°.		Ritthausen.		*Air-dried.*		Ritthausen.
10 C	60·0	28·76	28·33	10 C	60·0	23·66	23·33
N	14·0	6·71		N	14·0	5·52	
7 H	7·0	3·36	3·90	12 H	12·0	4·73	4·69
2 Cu	63·6	30·49	29·70	2 Cu	63·6	25·08	24·75
8 O	64·0	30·68		13 O	104·0	41·01	
$C^{10}NH^7Cu^2O^8$	208·6	100·00		+ 5 aq.	253·6	100·00	

Glutamate of copper dissolves without alteration in warm nitric acid, but crystallises from the solution in very fine prisms on adding potash or soda till a deep blue colour is produced. When on the other hand a moderately concentrated and still hot solution is mixed with such a quantity of alkali as to leave a slight acid reaction, and stirred with a glass rod, small prisms soon separate, which have a dull, light blue colour when lying over one another, and are no longer soluble in boiling water. In the air-dried state they contain 25·46 p. c. copper, and when dried at 150°, give off 15·21 p. c. water, agreeing nearly with the formula $C^{10}NH^7CuO^8$ + 4HO, which requires 25·94 p. c. copper and 14·73 water.

Lead-salts do not precipitate glutamic acid, even on addition of ammonia.

The *silver-salt*, $C^{10}NHAgO^8$ is indistinctl[illegible]line, and contains 42·05 p. c. silver (calc. 42·5 p. c.).

Glutamic acid dissolves at 15° in 30[illegible] 32 p. c. 1500 pts. alcohol of 80 p. c., and is insolub[illegible]lcohol and ether.

Contains at 130—135°, on the average, 51·0 p. c. C., 16·1 N., 6·7 H., 0·8 S., and 25·4 O.

Insoluble in *water*, either cold or boiling, and converted by prolonged boiling with water into an insoluble modification. — Dissolves partially in *nitric acid* of sp. gr. 1·2, with evolution of red vapours. — Dissolves sparingly in aqueous *ammonia*, and becomes insoluble therein on warming. — Dissolves easily with brownish-yellow colour, in very dilute aqueous *potash*, and from this solution metallic salts throw down bulky flocks. *Cupric sulphate* added to the alkaline solution, forms a blue precipitate, and with excess of potash, a fine violet solution. — Dissolves sparingly in cold dilute *acetic acid* and in cold *alcohol*; on warming either of these liquids, part of the gluten-casein becomes insoluble, while another part dissolves and separates on cooling from the alcoholic, but not from the acetic solution, as a curdy-flocculent mass. Dissolves more readily in alcohol containing acetic acid, and is precipitated therefrom by alkalis.

More recently (*J. pr. Chem.* 103, 216) Ritthausen gives the following characters of gluten-casein, as serving to distinguish it from legumin:—1. It is richer in sulphur. 2. It is more soluble in acetic acid. 3. When boiled with sulphuric acid, it yields, besides other known products, glutamic acid (p. 437), which latter, however, Ritthausen afterwards also obtained from legumin (*J. pr. Chem.* 107, 218).

Rye-casein. — Rye yields gluten-casein and mucedin, but no gluten-fibrin or plant-gelatin. — Fine rye-flour is macerated with a large quantity of water containing 0·2 p. c. potash hydrate; the same treatment is repeated after 24 hours, at 1°—2°; the whole is left to itself for three or four days; the clear liquid obtained by decantation or filtration is slightly supersaturated with acetic acid; and the precipitated greyish-white flocks, after successive treatment with absolute alcohol, to dehydration, then with ether, and once more with absolute alcohol, are quickly dried in a vacuum over oil of vitriol. — Yellow-grey, loose mass, having an earthy fracture; permanent in the air when dry.

After deduction of 0·7 p. c. ash, it contains, at 125—130°, on the average, 51·23 p. c. C., 15·96 N., 6·70 H., 1·04 S., and 25·67 O., and is therefore composed like gluten-casein, excepting that it contains a larger proportion of sulphur.

Rye-casein moistened with water, becomes dark-coloured on exposure to the *air*, and changes to a brown horny mass. — Swells up in cold or warm *water*, without dissolving. — Dissolves incompletely in boiling *nitric acid* of sp. gr. 1·2, with separation of yellowish-white flocks, the yellow solution becoming darker when supersaturated with potash. — Dissolves in *oil of vitriol* diluted with an equal volume of water, with deep brown colour at the boiling heat. — Swells up in strong *hydrochloric acid* to black-brown gummy flocks, and dissolves gradually to a brown liquid precipitable by water. — Dissolves in cold aqueous *potash*, *soda* (or *ammonia*) of 0·1 to 0·2 p. c., forming a brown-yellow liquid. The solution is precipitated by acids in the cold, by *sal-ammoniac*, by *lime-salts*, or by *sulphate of magnesia* mixed with sal-ammoniac, only at the boiling heat, and then yields a curdy white precipitate; it is not precipitated by *ferro-* or *ferri-cyanide of potassium*. — In very dilute *acetic acid*, rye-casein swells up to brown flocks, which then dissolve, especially on boiling; the resulting solution is precipitated

by ammonia and the fixed alkalis, also by ferrocyanide and ferricyanide of potassium. By prolonged boiling with water, rye-casein becomes insoluble in acids and in alkalis. It is insoluble in *alcohol* (Ritthausen, *J. pr. Chem.* 99, 439).

To this head belong probably a *plant-fibrin* containing 53·59 p. c. C., 15·81 N., 7·49 H., 23·11 O. and S., which Scherer (*Ann. Pharm.* 40, 7) obtained by boiling rye-flour with dilute sulphuric acid, dissolving the residue in very weak potash-ley, precipitating with acetic acid, and boiling the precipitate with alcohol and ether. In this or a similarly prepared product from rye, Verdeil (*Ann. Pharm.* 58, 317) found 0·98 p. c. sulphur.

From oil-cake of *rape-seed* previously freed from fat, Ritthausen (*J. pr. Chem.* 103, 206) obtained a proteide probably identical with gluten-casein, which, after deduction of 2·09 p. c. ash, contained 50·36 p. c. C., 16·28 N., 6·79 H., 1·02 S., and 25·55 O.

Gluten-fibrin.

RITTHAUSEN. *J. pr. Chem.* 91, 296.

On Plant-fibrin, see page 423, and under Gluten.

Preparation. p. 439.

Properties. Separates from the alcoholic solution as a tough brown-yellow mass, which, when immersed in absolute alcohol, becomes yellowish-white and opaque, and hardens. When dry, it forms hard, brittle, horny plates, which, if the drying has been performed otherwise than in a vacuum, are obtained in the insoluble modification.

Contains, on the average, at 130°—135°, together with traces of ash, 54·31 p. c. C., 16·89 N., 7·18 H., and 20·61 O.

Insoluble in water, and converted by prolonged contact with cold water, or in a shorter time by boiling with water, into a translucent jelly, insoluble in alcohol, acetic acid, and potash-ley. — Swells up in *ammonia-water* to a transparent jelly, without dissolving. — Dissolves easily in cold very dilute aqueous alkali, the solution being precipitated by acids and by metallic salts. — Dissolves easily in dilute *acetic acid*, forming a brownish-yellow solution precipitable by alkalis, gradually also in cold aqueous *tartaric acid*. — Dissolves completely in a large quantity of cold alcohol, the solution during concentration forming on the surface a soft, transparent film, which is continually renewed; the solution in hot alcohol of 30—70° p. c., deposits a large quantity on cooling.

Maize-fibrin.

GORHAM. *Journal of Science*, 11, 206; *Berzel. Jahresb.* 2, 124.
STEFF. *J. pr. Chem.* 76, 88; *Chem. Centr.* 1859, 626; *Jahresb.* 1859 592.
RITTHAUSEN. *J. pr. Chem.* 106, 471.

quantities of leucine, but no tyrosine (Ritthausen, *J. pr. Chem.* 99, 454).

Alcohol of 60 to 70 p. c. dissolves mucedin easily and completely, the solution not becoming turbid on cooling, but being precipitated in flocks by alcohol of 90 to 95 p. c.; alcohol of less than 60 p. c. dissolves mucedin with aid of heat, and deposits it on cooling, in larger quantity the weaker it is.

Rye-mucedin. — Fine rye-flour is boiled five times with about an equal weight of alcohol of 80 p. c., the liquid being strained each time at the boiling heat and then left to cool. The precipitate which settles after 24 hours from the brown-red liquid is treated successively with absolute alcohol and with ether, dissolved in boiling alcohol of 80 p. c., the solution depositing mucedin on cooling, and a larger quantity when the alcohol is distilled off. It is dehydrated by immersion in absolute alcohol, dried in a vacuum over oil of vitriol, dissolved in acetic acid, and mixed by drops with potash-ley, whereby part of the mucedin is precipitated, together with the whole of the gum. The purer mucedin is precipitated from the filtrate by neutralisation with potash (Ritthausen).

Rye-mucedin resembles the similarly named substance from wheat, and approximates to it in composition. Contains, after drying at 125°—130°, after deduction of 0·43 p. c. ash, 53·61 p. c. C., 16·84 N., 6·79 H., 0·50 S., and 22·26 O. (Ritthausen).

Rye-mucedin dissolves to a certain extent in hot *water*; if the quantity of water is insufficient for complete dissolution, the residue becomes suspended, forming a milky liquid, which forms a deposit on cooling.

By prolonged boiling with water it becomes insoluble in acids and in alkalis. — Dissolves in hot *nitric acid* of sp. gr. 1·2, with slight evolution of red vapours, the solution becoming turbid on cooling. — *Oil of vitriol* diluted with an equal volume of water forms, after boiling for a short time, a clear reddish solution; if the solution contains gum, or a similar substance, the solution is dark brown, and rendered turbid by black flocks. By prolonged boiling the same products are obtained as from wheat mucedin, especially a large quantity of glutamic acid. The solution slightly acidulated with acetic acid is precipitated in white flocks by *mercurous nitrate*, acquires a fine violet-red colour when heated after addition of a small quantity of *cupric sulphate* and *potash*, blue in presence of sugar or gum. — Dissolves slightly in cold *alcohol* of 30 p. c., more abundantly in stronger alcohol, especially of 60 to 85 p. c., the solutions depositing mucedin again only when strongly concentrated and cooled to a low temperature. From these solutions it is precipitated by absolute alcohol, either as a translucent film, or from a non-saturated solution as a reddish-yellow translucent jelly, becoming yellowish-grey and opaque when left immersed in absolute alcohol (Ritthausen).

As Ritthausen's mucedin is the only constituent of rye-[illegible] soluble in alcohol, the *plant-gelatin from rye*, examined [illegible] (*Ann. Pharm.* 45, 198), probably belongs to this place. [illegible] by exhausting rye-flour with alcohol, distilling off the [illegible] exhausting the yellow-brown glutinous residue with ether [illegible] — After drying it is dark brown, horny, and shining, has a [illegible] reaction, contains 0·47 p. c. ash, and after deduction thereof [illegible]

C., 15·83 N., 7·97 H. — Insoluble in cold, slightly soluble in boiling water; dissolves almost entirely in hot dilute acids and in hot acetic acid, the solutions depositing flocks on cooling, and being precipitable by alkalis. Dissolves with difficulty in cold, more easily in hot aqueous *ammonia*, in aqueous *potash*, especially when heated, with copious evolution of ammonia, and formation of potassium sulphide. Dissolves easily in boiling *alcohol*, and is precipitated by water. — On Plant-albumin from rye examined by Liebig and Jones, see p. 427.

Plant-gelatin.

BERZELIUS. *Pogg. Ann.* 10, 248. *Berzel. Jahresbr.* 7, 231. — Taddei, *Brugn. Giorn.* 12, 360; *N. Tr.* 4, 2, 154. Schw. 29, 514.
BOUSSINGAULT. *Ann. Chim. Phys.* 63, 225; 65, 301; *Berzel. Jahresb.* 18, 327.
LIEBIG. *Ann. Pharm.* 39, 142. JONES. *Ann. Pharm.* 40, 66.
DUMAS & CAHOURS. *N. Ann. Chim. Phys.* 6, 418.
v. BIBRA. *Die Getreidearten und das Brod.* Nürnberg, 1860, 152.
GÜNSBERG. *Wien. Acad. Ber.* 44, 429; *J. pr. Chem.* 85, 213; *Chem. Centr.* 1862, 161; *Jahresber.* 1862, 517.
RITTHAUSEN. *J. pr. Chem.* 85, 193; 86, 257; *Chem. Centr.* 1862, 725; *Jahresber.* 1862, 519. — *J. pr. Chem.* 88, 141; *Chem. Centr.* 1863, 401; *Jahresber.* 1863, 418.

Gliadin. Glutin. A constituent of wheat-gluten, perhaps also of oats (see below).

Preparation. Obtained together with the other constituents of wheat-gluten (p. 439).

Or recently prepared gluten is immersed for 24 hours in cold alcohol of 80·85 p. c.; the solution, containing plant-gelatin together with gluten-fibrin and fat, is evaporated to dryness, whereby the gluten-fibrin becomes partly insoluble; and the residue is warmed with very dilute acetic acid. From the liquid filtered from the undissolved gluten-fibrin, ammonia added in separate portions first throws down gelatin containing fibrin, as a gelatinous flocculent mass, then purer gelatin as a clear colourless varnish. It is dehydrated by immersion in absolute alcohol, and dried over oil of vitriol in a vacuum, finally at 130° (Ritthausen).

When gluten is exhausted with boiling alcohol, first of 80—85 p. c. afterwards of 75 p. c., the tinctures, after distillation to one-half, deposit flocks of gluten-fibrin containing fat, then, after complete cooling, first, gelatin containing fibrin, then purer gelatin as a transparent ropy mass, a portion also remaining in solution together with dextrin and [illegible]

[illegible] ust gluten with boiling alcohol, remove the [illegible] cooling, and concentrate, the liquid then [illegible] the separation of plant-gelatin. The [illegible] on with [illegible] alcohol, and water, [illegible] manner.

Jone[illegible] ed by Liebig, appa-

quantities of leucine, but no tyrosine (Ritthausen, *J. pr. Chem.* 99, 454).

Alcohol of 60 to 70 p. c. dissolves mucedin easily and completely, the solution not becoming turbid on cooling, but being precipitated in flocks by alcohol of 90 to 95 p. c.; alcohol of less than 60 p. c. dissolves mucedin with aid of heat, and deposits it on cooling, in larger quantity the weaker it is.

Rye-mucedin. — Fine rye-flour is boiled five times with about an equal weight of alcohol of 80 p. c., the liquid being strained each time at the boiling heat and then left to cool. The precipitate which settles after 24 hours from the brown-red liquid is treated successively with absolute alcohol and with ether, dissolved in boiling alcohol of 80 p. c., the solution depositing mucedin on cooling, and a larger quantity when the alcohol is distilled off. It is dehydrated by immersion in absolute alcohol, dried in a vacuum over oil of vitriol, dissolved in acetic acid, and mixed by drops with potash-ley, whereby part of the mucedin is precipitated, together with the whole of the gum. The purer mucedin is precipitated from the filtrate by neutralisation with potash (Ritthausen).

Rye-mucedin resembles the similarly named substance from wheat, and approximates to it in composition. Contains, after drying at 125°—130°, after deduction of 0·43 p. c. ash, 53·61 p. c. C., 16·84 N., 6·79 H., 0·50 S., and 22·26 O. (Ritthausen).

Rye-mucedin dissolves to a certain extent in hot *water*; if the quantity of water is insufficient for complete dissolution, the residue becomes suspended, forming a milky liquid, which forms a deposit on cooling.

By prolonged boiling with water it becomes insoluble in acids and in alkalis. — Dissolves in hot *nitric acid* of sp. gr. 1·2, with slight evolution of red vapours, the solution becoming turbid on cooling. — *Oil of vitriol* diluted with an equal volume of water forms, after boiling for a short time, a clear reddish solution; if the solution contains gum, or a similar substance, the solution is dark brown, and rendered turbid by black flocks. By prolonged boiling the same products are obtained as from wheat mucedin, especially a large quantity of glutamic acid. The solution slightly acidulated with acetic acid is precipitated in white flocks by *mercurous nitrate*, acquires a fine violet-red colour when heated after addition of a small quantity of *cupric sulphate* and *potash*, blue in presence of sugar or gum. — Dissolves slightly in cold *alcohol* of 30 p. c., more abundantly in stronger alcohol, especially of 60 to 85 p. c., the solutions depositing mucedin again only when strongly concentrated and cooled to a low temperature. From these solutions it is precipitated by absolute alcohol, either as a translucent film, or from a non-saturated solution as a reddish-yellow translucent jelly, becoming yellowish-grey and opaque when left immersed in absolute alcohol (Ritthausen).

As Ritthausen's mucedin is the only constituent of rye-flour that is soluble in alcohol, the *plant-gelatin from rye*, examined by Helot (*Ann. Pharm.* 45, 198), probably belongs to this place. It is obtained by exhausting rye-flour with alcohol, distilling off the alcohol, and exhausting the yellow-brown glutinous residue with ether and alcohol. ftter drying it is dark brown, horny, and shining, has a faint acid on, contains 0·47 p. c. ash, and after deduction thereof 55·51 p. c.

C., 15·83 N., 7·97 H. — Insoluble in cold, slightly soluble in boiling water; dissolves almost entirely in hot dilute acids and in hot acetic acid, the solutions depositing flocks on cooling, and being precipitable by alkalis. Dissolves with difficulty in cold, more easily in hot aqueous *ammonia*, in aqueous *potash*, especially when heated, with copious evolution of ammonia, and formation of potassium sulphide. Dissolves easily in boiling *alcohol*, and is precipitated by water. — On Plant-albumin from rye examined by Liebig and Jones, see p. 427.

Plant-gelatin.

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BOUSSINGAULT. *Ann. Chim. Phys.* 63, 225; 65, 301; *Berzel. Jahresb.* 18, 327.
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DUMAS & CAHOURS. *N. Ann. Chim. Phys.* 6, 418.
v. BIBRA. *Die Getreidearten und das Brod.* Nürnberg, 1860, 152.
GÜNSBERG. *Wien. Acad. Ber.* 44, 429; *J. pr. Chem.* 85, 213; *Chem. Centr.* 1862, 161; *Jahresber.* 1862, 517.
RITTHAUSEN. *J. pr. Chem.* 85, 193; 86, 257; *Chem. Centr.* 1862, 725; *Jahresber.* 1862, 519. — *J. pr. Chem.* 88, 141; *Chem. Centr.* 1863, 401; *Jahresber.* 1863, 418.

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When gluten is exhausted with boiling alcohol, first of 80—85 p. c. afterwards of 75 p. c., the tinctures, after distillation to one-half, deposit flocks of gluten-fibrin containing fat, then, after complete cooling, first, gelatin containing fibrin, then purer gelatin as a transparent ropy mass, a portion also remaining in solution together with dextrin and gum (Ritthausen).

Dumas & Cahours exhaust gluten with boiling alcohol, remove the deposit which separates on cooling, and concentrate, the liquid then coagulating in consequence of the separation of plant-gelatin. The gelatin is purified by exhaustion with ether, alcohol, and water. — v. Bibra proceeds in a similar manner.

The plant-gelatin analysed by Jones was prepared by Liebi

[illegible] (according to *Ann. Pharm.* 39, 147) by exhausting wheat-gluten with alcohol, evaporating, washing the residue with hot water, dissolving in acetic acid, and precipitating the filtrate with ammonia, whereupon, before the acetic acid is neutralised, there falls down a white, non-glutinous but ropy mass, which must be treated with ether to remove a substance resembling hirt-lime. — On plant-albumin from gelatin, see p. 452.

Günsberg boils wheat-gluten for some hours with water, strains the greenish-yellow decoction, and concentrates, whereupon films of starch appear upon the surface, and after these have been separated and the liquid cooled, the remainder separates into a gelatinous deposit of gluten-gelatin and a milky turbid liquid. The deposit dissolved in cold alcohol of 50 p. c. separates out again on concentration, and on redissolving it in boiling water, and evaporating the solution, it is obtained as a brown transparent mass, which has partly become insoluble in boiling water and in weak spirit. Compare p. 447.

Properties. Plant-gelatin is obtained by evaporation of its alcoholic solution in amorphous, transparent, yellowish-white, brittle laminæ; by evaporation of its aqueous solution in a vacuum, as a blistered mass. But if the moist gelatin be immersed for 24 hours in a large quantity of absolute alcohol and kneaded from time to time, the alcohol which has become milky and watery being replaced by fresh alcohol, the mass, which is gummy at first, becomes opaque, and then dries up in a vacuum to an earthy, lustreless, easily friable mass (Ritthausen).

	Jones.	Dumas & Cahours. at 140°.	v. Bibra.	Günsberg. at 130°.	Rittshausen. at 130°.
C	54·47	53·27	53·56	52·73	52·60
N	15·98	15·94	15·56	17·70	18·06
H	7·42	7·17	7·12	6·81	7·00
S	22·13	23·62	0·88	22·76	0·85
O			22·88		21·49
	100·00	100·00	100·00	100·00	100·00
Ash		0·70	3·90	0·41	0·26

Günsberg's plant-gelatin was free from sulphur, in consequence, as Ritthausen supposes, of previous decomposition. — The body analysed by Mulder as plant-gelatin appears to belong to plant-fibrin (p. 451).

The *gelatin of oats*, purified by repeated solution in alcohol of 60 p. c., and precipitation with absolute alcohol, contains at 130°, 52·49 p. c. C., 17·71 N., 7·65 H., 1·66 S., and 20·39 O, therefore twice as much sulphur as that of wheat, the characters of which it exhibits in other respects (Kreusler, *J. pr. Chem.* 107, 17).

Decompositions and Combinations. 1. Melts *when heated*, and decomposes with strong intumescence, leaving a difficultly combustible charcoal. — 2. Moist vegetable gelatin becomes dark-coloured on exposure to the air, or when repeatedly evaporated by heat (Ritthausen).

3. Dried plant-gelatin swells up [illegible] r to a soft whitish mass, and dissolves slightly, forming [illegible] boiling water it forms a clear solution, [illegible] but when it is repeatedly boiled with q[illegible] to dissolve it, there remains a transpar[illegible] residue, containing le[illegible] ren and [illegible]

[illegible] into a clear varnish; that produced by alcohol into an opaque, apparently fine-grained cohesive film (Ritthausen).

From solutions of plant-gelatin in aqueous acids, *dextrin* throws down a precipitate, which does not dissolve either in a larger quantity of acid, or on further addition of dextrin (Günsberg, *Wien. Acad. Ber.* [illegible]; *Chem. Centr.* 1863, 690; *Jahresb.* 1863, 571).

Appendix to the Proteides of Wheat.

Gluten.

On the preparation of gluten, see p. 422. — The separation is easier when the stiff paste formed of wheat-flour and water is left to itself for a quarter of an hour (v. Bibra).

Of the proteides of wheat which are insoluble in water, a part only is obtained as gluten, the remainder being diffused in the starch-water, and deposited for the most part in the lower layers of the starch as a dark-coloured mass (v. Bibra).

According to Ritthausen, gluten contains 12 to 16 p.c. starch, husks and fat, and 16 to 20 p.c. gluten-casein, the rest consisting of gluten-fibrin, mucedin and plant-gelatin in about equal parts. Fresh gluten contains about 70 p.c. water, but shrinks after some time and extrudes some of the water; in the dry state it contains 70 to 71 p.c. plant-fibrin, between 3·85 and 9·35 p.c. plant-casein, 7·54 to 19·56 plant-gelatin, and 4·61 to 8·15 p.c. fat (v. Bibra).

In the moist state, gluten forms a light yellow, tough, elastic adhesive mass, which, when prepared from fine flour, is without taste or smell, and may be spread out into sheets as thin as paper, and nearly as large as the hand (v. Bibra). — After boiling with alcohol it is whitish-grey and hard (Ritthausen). Dried gluten is brown, translucent on the edges, and brittle, and may be kept for a long time if excluded from moisture (v. Bibra). In hydrochloric acid solution it is optically lævorotatory (Bouchardat).

Gluten prepared by Beccaria's process.

	Marcet. (*Ann. Chim. Phys.*, 36, 27.)	Boussingault. (*Ann. Chim. Phys.*, 65, 301).
C	54·65	52·54
N	14·50	15·00
H	7·80	7·50
O and S	23·05	24·96
	100·00	[illegible]·00

Boussingault's gluten contained 1·3 p.c. [illegible] composition, according to Kekulé (Liebig's *Chem. Briefe*. 592; *Jahresb.* [illegible] In crude gl[illegible] as far as possible from fat, Ritthausen found 1[illegible]

Moist gluten coagulates when *heated* [illegible] insoluble in potash-l[illegible] acids, and alcoho[illegible] heat (Ritthausen).

Dried gluten t[illegible] er again but [illegible] (v. Bibra). B[illegible] pletely recover its [illegible] moist glut[illegible] gelatin and other [illegible]

alters its constituents (Ritthausen). By heating gluten with 6 pts. of water to 200°—220°, a turbid brown alkaline liquid is obtained, from which acids throw down a yellow precipitate (Gmelin. — Barral, *Compt. rend.* 56, 1118; *Jahresber.* 1863, 762). — Moist gluten soon gives off carbonic acid, and deliquesces to a varnish-like mass, almost wholly soluble in alcohol, emitting at the same time an odour of putrefaction and of hydrosulphuric acid (v. Bibra). In a vessel filled with water and closed, gluten does not alter; but in a cold aqueous extract of malt it swells up, gives off gas, and dissolves to an acid liquid, which is precipitated by boiling, and also, after this precipitate has been filtered off, by mercuric chloride (Mulder, *Scheik. Verhandl. en Onderzoek.* 130; *Jahresb.* 1858, 586).

Fresh gluten not coagulated by heat, dissolves in dilute *phosphoric acid.* It dissolves in cold fuming *sulphuric acid* with reddish black-brown colour (Link, *Schw.* 14, 292): hot *oil of vitriol* colours it violet to black, eliminates combustible gas, and forms acetic acid and ammonia (Fourcroy). By prolonged boiling with moderately dilute sulphuric acid, it yields tyrosine, leucine, glutamic acid (p. 437), aspartic acid, and a product resembling leucine, containing 47·03 p. c. C., 13·46 N., 7·43 H. (Ritthausen). — When fresh gluten is added to *oil of vitriol* as long as it dissolves without blackening, and the solution after dilution with water is distilled, with addition of *peroxide of manganese*, there pass over, with the vapour of water, the following volatile acids: benzoic, formic, acetic, propionic, butyric, and valeric, together with the aldehydes of acetic, butyric, valeric, and benzoic acids; the residue supersaturated with lime, gives off ammonia smelling of volatile bases (Keller, *Ann. Pharm.* 72, 14). — Warm *nitric acid* colours fresh gluten yellow, and decomposes it, with formation of oxalic acid, sulphuric acid, ammonia, sebaceous matter, artificial bitter, and other products. — Gluten dissolves in hot *hydrochloric acid* with brown colour, forming ammonia after some time (Poulletier de la Salle). — The bluish-grey solution in strong hydrochloric acid deposits grey flocks on addition of water, and forms with the colourless solution of starch in fuming hydrochloric acid, a purple-red liquid, becoming yellow on addition of alkalis (Vauquelin). Aqueous hydrochloric acid containing 0·05 to 0·2 p. c. of the gaseous acid, dissolves gluten, forming a solution which becomes turbid on boiling, gives with acids precipitates which dissolve in excess of the precipitant, and in general is precipitated by all substances which precipitate solutions of albumin. — (Bouchardat, *Compt. rend.* 14, 962). — In *chlorine-water* gluten coagulates to yellowish-white flocks containing chlorine (Fourcroy & Vauquelin).

In aqueous *ammonia* gluten swells up and falls to pieces without dissolving (Lenk). Coagulated gluten also does not dissolve in ammonia or *carbonate of ammonia.* Gluten precipitated from acid solutions by carbonate of ammonia becomes transparent and gummy when [illegible]ed with water, and partly dissolves; the portion precipitated from [illegible]kaline solution by carbonate of ammonia dissolves in a con-[illegible] quantit[illegible]ter (Berzelius). — Aqueous *potash* and *soda* [illegible]luten i[illegible] state, or when it has been dried without ap-[illegible] hea[illegible] solution diluted till it contains only 0·1 to [illegible]ke[illegible]ten is precipitated by acids without altera-[illegible], hydrochloric, and nitric acid precipitate [illegible]ly; phosphoric and acetic acids form,

The constituent of wheat-gluten which is soluble in alcohol, and is obtained as a soft glutinous mass by evaporating the alcohol and washing out the residue, deposits, when its ammoniacal solution is mixed at the boiling heat with acetic acid, a white coagulum which gives up ammonia when boiled with water containing acetic acid: *Plant-albumin from plant-gelatin.* It contains, according to Will & Varrentrapp, 53·81 p. c. C., 15·88 N., 6·98 H., and 23·43 O. (Liebig, *Ann. Pharm.* 39, 144).

The *Phytocoll* of the older chemists, *Phyteumacolla* of Brandes, is obtained from agarics, from *Lichen parietinus*, from the root-bark of *Aylanthus glandulosa*, from bitter-apples, from Spanish pepper, and from Colombo-root, and is the part of the aqueous extract of these plants which is insoluble in boiling alcohol. It is nitrogenous and dissolves in water, to a non-gelatinising liquid precipitable by many metallic salts and by infusion of galls. See Vauquelin (*Ann. Chim. Phys.* 85, 5); Braconnot (*J. Phys.* 84, 295 and 340. — *Ann. Chim. Phys.* 6, 130); Planche (*A. Tr.* 22, 2, 158); Lassaigne & Feneulle (*Ann. Chim. Phys.* 12, 358); Schröder (*Berl. Jahrb.* 1819, 67).

In *Borago officinalis* (Proust) and in other boraginaceous plants (Braconnot) there occurs a nitrogenous substance differing from gluten, the solution of which in boiling water solidifies on cooling to an imperfect jelly, and is precipitated by acids. It is also precipitated by the alkaline earths and by most salts, but tannin merely clouds it (Braconnot, *J. Phys.* 84, 274).

The *Goëmin* of Blondeau occurs in the Carragheen mass of *Sphærococcus crispus*, in which, however, Mulder and C. Schmidt (xv, 210) found only vegetable mucilage. It is obtained by boiling the plant with water for several hours, precipitating the mucilage thus obtained with alcohol, redissolving the precipitate, and diluting the aqueous solution. — Translucent hard skins, neutral, swelling up in water, and soluble in aqueous alkalis. Contains 21·80 p. c. C., 21·36 N., 4·87 H., 2·51 S., and 29·46 O. (Blondeau, *Compt. rend.* 60, 860; *Krit. Zeitschr.* 8, 419).

Emulsin.

Liebig & Wöhler. *Ann. Pharm.* 22, 17; *Berzel. Jahresber.* 18, 346.
Thomson & Richardson. *Ann. Pharm.* 29, 180; *Berzel. Jahresber.* 20, 429.
Ortloff. *N. Br. Arch.* 48, 12; *Berzel. Jahresber.* 27, 397.
Bull. *Ann. Pharm.* 69, 145; *Lieb. Kopp Jahresber.* 1849, 493.

Robiquet's *Synaptase.* The constituent of sweet and bitter almonds which, in contact with water and amygdalin, decomposes the latter (xv, 426).

Simon's statements on the occurrence of emulsin, or a substance capable of decomposing amygdalin, in the seeds of the poppy and of other plants (xv, 427), have not been confirmed by Ortloff.

Emulsin is not known in the separate state. See Liebig and Wöhler's preparation of a solution of emulsin (xv, 427).

Ortloff macerates the [illegible] weight of water [illegible] has become [illegible] the filtrate [illegible] alcohol: and [illegible] pared, [illegible] leaves a large [illegible] fied emulsin may [illegible]

Bull leaves the [illegible] 12 hours: separates the [illegible] removes legumin [illegible] filtrate by [illegible] air after washing [illegible] into a brown [illegible] dissolves [illegible] of phosphates. [illegible] succession and [illegible] a white [illegible] has been [illegible] quantity of ash.

Thomson & Richardson [illegible] its volume of [illegible] ethereal layer: and [illegible] liquid with alcohol. [illegible] longer acts upon amygdalin [illegible] after drying [illegible] On the reaction of this emulsin [illegible]

Robiquet's [illegible] obtained by freeing the [illegible] acetic acid and [illegible] excess of lead from the filtrate [illegible] the excess of [illegible] precipitating with alcohol. [illegible] very soluble in cold water: the [illegible] turbid and fetid by exposure to the air. [illegible] without precipitation by iodine and [illegible] amygdalin even at 60°. According to Ortloff and Bull the precipitate formed by lead acetate decomposes amygdalin, but the filtrate does not.

Properties. Recently precipitated emulsin forms white flocks which dry up to a white [illegible] Ortloff's emulsin is a red-grey or red-yellow gum.—[illegible] and tasteless. According to Bull, it has an acid reaction.

	Thomson & Richardson.	Bull. at 100°—130°.	Ortloff.
C	48·75	43·06	27·9
N	18·82	11·52	9·3
H	7·73	7·20	5·4
O and S	24·67	38·22	57·4
	100·00	100·00	100·

Thomson & Richardson do not appear to have determined the

ADDENDA.

To page 281.

Paralbumin.

P. Plósz. *Med.-chem. Unters.* 1871, 517.

Hoppe-Seyler (*Chem. Centralbl.* 1862, No. 56) found that the paralbumin which Scherer obtained from ovarian cysts, &c., contains besides albumin, a body which, like glycogen (xv, 183), dissolves in water with milky opalescence, is insoluble in alcohol, is turned brown by alkalis and yellow by iodine, and when boiled with dilute sulphuric acid, reduces cupric oxide and bismuth oxide.

Paralbumin is therefore a mixture containing albuminous substances and a reducing substance. The albumin is held in solution by alkali, from which it is precipitated by a larger quantity of water and by carbonic acid, or by very dilute acetic acid. By alcohol it is precipitated together with a portion of the alkali; and after long standing under alcohol, it is redissolved by moderately warm water. On boiling a cystic fluid, a portion of the albumin is coagulated; but if the liquid be neutralised before boiling, the whole of the albumin is coagulated. Dilute hydrochloric and sulphuric acids convert it into syntonin, which can then be precipitated by sodium sulphate or chloride. The reducing body remains in solution when either method of precipitation is employed, and may thus be easily separated from albuminous matters:

α. The liquid is carefully neutralised with dilute acetic acid, and precipitated with thrice its volume of alcohol. The precipitate is washed with alcohol on a filter, pressed, mixed with water, and heated to the boiling point; and the solution filtered from the coagulated albumin is kept exactly neutral, concentrated to a small bulk, and precipitated with alcohol. The precipitate, after being well washed with water, contains the substance free from albumin. To purify it still further, it is again dissolved in water, heated to the boiling point, filtered, and again precipitated and washed with alcohol.

β. Another cystic fluid was mixed with an equal volume of a saturated solution of sodium chloride and so much hydrochloric acid that one grm. HCl was contained in 100 c.c. In this manner the albuminous body was very completely precipitated, after being changed into syntonin. The liquid was separated from the precipitate by straining and filtration, lastly neutralised, and evaporated to a small bulk, then filtered from the sodium chloride, which had separated, and from some albumin; next precipitated by a large quantity of alcohol, and washed.

Lastly, the substance was redissolved in water, warmed, filtered, and reprecipitated by alcohol.

The reducing substance thus prepared contains a considerable quantity of sodium chloride, from which it can be freed only by prolonged washing with alcohol. By the other method, however, of precipitating the albuminous body by alcohol and heat, the liquid is separated from the precipitate with difficulty, and decomposition may ensue from prolonged contact with water.

The substance thus obtained is, when moist, white, gelatinous, and very like syntonin. It is soluble in water, and separates therefrom on concentration, in the form of a film, which, when dried, is of a dirty grey colour, like a dried brittle mass of albumin. When once dried, it no longer dissolves to form a clear solution. Its aqueous solution is opalescent, but can be rendered transparent by repeated filtration; but it again becomes turbid on standing. The body is precipitated from its solution by alcohol, mercuric chloride, and mercuric nitrate; but not by acids, either strong or dilute, by cupric sulphate, or potassic ferrocyanide. The aqueous solution dissolves cupric hydrate on boiling, without the addition of an acid, but does not reduce the oxide. It is not coloured by iodine.

On boiling its clear solution with mineral acids, a flocculent, dirty brown precipitate is produced. On filtering off this precipitate, the filtrate, after neutralisation, is no longer precipitable by alcohol; it reduces cupric hydrate in alkaline solution, before the boiling point is reached; bismuth oxide and indigo on boiling; and is turned brown when boiled with caustic potash. In aqueous solution this substance is decomposed by heating, as well as when boiled with acids, and then yields to alcohol considerable quantities of the reducing body.

The precipitate formed by this decomposition is insoluble in water, alcohol and acids, soluble in alkalis. It gives none of the reactions for albumin (formation of xanthoproteic acid on heating with strong nitric acid, violet coloration with cupric oxide, &c.).

Neither before nor after heating does the watery solution of the body exhibit any action on polarized light. The aqueous solution of the product of decomposition acts as a most energetic reducing agent, even when extremely dilute.

The original substance gave by analysis 49·7 p. c. carbon, 7·4 to 8·8 nitrogen, and 7·6 hydrogen. The variable percentage of nitrogen is accounted for by the readiness with which the body is decomposed; and hence the varying quantities of the reducing body which it contains. This latter is probably a kind of sugar, and consequently the original substance is a glucoside; it bears considerable resemblance to some of the varieties of mucin (p. 347).

The reducing body, in its original state, previous to boiling with acids, dissolves in cold strong nitric acid, and the solution yields with water a finely flocculent, light yellow precipitate, consisting of a nitrate. The compound thus formed appears to be different from that which is obtained by heating albuminous bodies with nitric acid; it is still precipitable after being heated for a short time with water, but dissolves as the acid is washed out. The nitric acid compound does by heat or by percussion.

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